MWH
MONTGOMERY WATSON HARZA

February 27, 2003

Mr. Kevin Adler
Remedial Project Manager
U.S. Environmental Protection Agency
Region V, SR-6J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Re: Change Pages for O&M Manual for the Groundwater Treatment Plant Vol. 1 and 4a
ACS NPL Site

Dear Mr. Adler:

Please find enclosed three sets of change pages incorporating revisions to the Operations & Maintenance (O&M) Manual for the Groundwater Treatment Plant Volumes 1 and 4a for the American Chemical Service NPL Site in Griffith, Indiana submitted in July 2002. Please replace the old pages from these two reports with the revised text pages, table, and figures as described below.

The following changes were made to Volume 1 entitled Operations and Maintenance Plan/Contingency Plan:

- Text modifications to pages between page i (Table of Contents) and page 2-31
- Revision to page 1 of Table 4-1
- Revision to Figure 2-3

The following changes were made to Volume 4a entitled As-Builts for the GWTP Upgrades:

- Revision to Figure 6

We are also sending three sets of change pages to IDEM and one set of change pages to Black & Veatch. If you need additional copies of these change pages please let me know and we can forward them to you, or whomever you specify.

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Tel: 630 836 8900
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Sincerely,

MWH

Peter J. Vagt, Ph.D., CPG
Project Manager

cc: Prabhakar Kasarabada, IDEM (3 sets)
Larry Campbell, B&V (1 set)
ACS Tech Review Committee (1 copy each – cover letter only)

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Change Pages for

OPERATION & MAINTENANCE MANUAL
GROUNDWATER TREATMENT PLANT

Volume 1 of 11

OPERATION & MAINTENANCE MANUAL/CONTINGENCY PLAN

AMERICAN CHEMICAL SERVICE NPL SITE
GRIFFITH, INDIANA

July 2002

Attached:

- Pages i (Table of Contents) through 2-31
    - Revised Table 4-1 (page 1)
        - Revised Figure 2-3

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APPENDIX

ACRONYMS AND COMMON TERMS

ACS	American Chemical Services
"Auto"	Automatic operating mode setting for equipment selected an HOA switch
BOD	Biological Oxygen Demand
BWES	Barrier Wall Extraction System
CAH	High pH alarm
CAL	Low pH Alarm
CAT-OX	Catalytic oxidizer and scrubber unit (ME-106)
CE	pH sensor/probe
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CIC	pH indicator and transmitter
CO2	Carbon Dioxide
COC	Chain-of-Custody for sample transportation and analysis
COD	Chemical Oxygen Demand
CPI	Corrugated Plate Interceptor oil/water separator (ME-1)
DAH	High turbidity alarm
DIC	Turbidity indicator and transmitter
DM	Turbidity meter
DNAPL	Dense non-aqueous phase liquid (tar)
DO	Dissolved oxygen
DOT	Department of Transportation
ERCP	Emergency Response and Contingency Plan
EW	Designator for BWES extraction well
EP	Designator for the PGCS electrical well pumps
FAL	Low air flow alarm (from blowers or air compressors)
F/M	Food to microorganism ratio for activated sludge plant
FE	Flow measuring element (part of a flowmeter)
FIT	Water flow rate indicator and transmitter
FM	Water flow meter
FS	Low air flow indicator switch
GAC	Granular activated carbon unit (ME-33 and ME-34)
gpd	gallons per day
gpm	gallons per minute
GWTP	Groundwater treatment plant
H_2SO_4	Sulfuric Acid
"Hand"	Manual operating mode setting for equipment selected an HOA switch
HASP	Health and Safety Plan
HDPE	High density polyethylene
HOA	Hand/Off/Auto switch for operating modes of equipment
hp	Horse power

ACRONYMS AND COMMON TERMS
(Continued)

HS	Hand switch
I&C	Instrumentation & control
IDEM	Indiana Department of Environmental Management
ISVE	In-situ soil vapor extraction
kg	kilogram
K-P Area	Kapica-Pazmey Area (located at the south end of the Off-Site Area)
KS	Alternator switch
kW	Kilowatt
LAH	High water level alarm
LAL	Low water level alarm
LC	Level Controller
LCP	Local control panel
LE	Continuous water level meter
LH	High Level
LIT	Water level indicator and transmitter
LL	Low Level
LNAPL	Light non-aqueous phase liquid
LS	Water level switch
LSH	High water level switch
LSHH	High high water level switch (usually for alarm indication)
LSL	Low water level switch
LT	Level Transmitter
µg/L	microgram per liter
mA	milliamp (electrical current)
MCC	Motor control center
MDL	Method detection limit for analytical analysis
ME	Mechanical equipment designation
mg/L	milligram per liter
ml	milliliter
MLSS	mixed liquor suspended solids (total suspended solids in activated sludge)
MLVSS	mixed liquor volatile suspended solids (biomass)
MMI	Man-machine interface (the GWTP control computer)
MSDS	Material Safety and Data Sheet
NAH	High Torque Alarm
NaOH	Sodium hydroxide (caustic soda)
NAPL	Non-aqueous phase liquid
NH_3	Nitric Acid (used as supplemental nutrient for activated sludge)
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
O&M	Operation & Maintenance
OFCA	Off-Site Containment Area (the area of high contamination in the Off-Site Area)

ACRONYMS AND COMMON TERMS
(Continued)

"Off"	Off setting for equipment selected an HOA switch
Off-Site Area	The area within the barrier wall south of the railroad tracks
ONCA	On-Site Containment Area (the area of high contamination in the On-Site Area)
On-Site Area	The area within the barrier wall north of the railroad tracks
OSHA	Occupational Safety and Health Act
OUR	Oxygen Uptake Rate
P	Pump designation
P_4O	Phosphoric acid (used as supplemental nutrient for activated sludge)
PC	Personal computer
PCB	Polychlorobiphenyl
PGCS	Perimeter Groundwater Containment System
PID	Proportional, Integral, Derivative
PLC	Programmable Logic Center
PM	Project Manager
PP	Designator for the BWES well pumps
PPE	Personal Protective equipment
PS	Air pressure switch
psi	pounds per square inch
PSVP	Performance Standard Verification Plan
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAS	Return activated sludge
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
rpm	Revolutions per minute
RUN	Equipment operation indicator light
S.U.	Standard unit of pH measurement
SBPA	Still Bottoms Pond Area (located within the ONCA)
SCFM	Standard cubic feet per minute of air/gas flow
SF	Square Feet
Site	All of the individual ACS areas are collectively referred to as the Site
SSO	Site Safety Officer
Stage 1	Dewatering period for the Off-Site Area
Stage 2	Dewatering period for the On-Site Area
Stage 3	Long-term maintenance dewatering period
SV	Solenoid Valve
SVOC	Semi-volatile organic compound
T	Tank designation
TOC	Total Organic Carbon
TSS	Total suspended solids

ACRONYMS AND COMMON TERMS
(Continued)

U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Society
UV-OX	Ultraviolet oxidation unit (ME-2)
VDC	Voltage, direct current
VFD	Variable frequency drive motor for pumps
VOC	Volatile organic compound
VSS	Volatile suspended solids
WAS	Waste activated sludge

1.0 INTRODUCTION

1.1 MANUAL USE AND ORGANIZATION

This document is the Operations and Maintenance (O&M) Manual and the Contingency Plan for the Perimeter Groundwater Containment System (PGCS), the Barrier Wall and Associated Extraction System (BWES), and the Groundwater Treatment Plant (GWTP) which were installed as expedited remedial actions at the American Chemical Service (ACS) Site in Griffith, Indiana. Construction of the original GWTP including the PGCS and BWES extraction systems was completed in 1997, and significant upgrades were completed in December 2000 to meet the expected groundwater extraction quantity and treatment required to implement the Final Remedy. This document is Volume 1 of the overall Operations and Maintenance Manual for the GWTP. The O&M Manual provides the information necessary to operate and maintain the extraction and treatment facilities. The manual describes the overall systems; the anticipated groundwater characteristics; required effluent quality; and the process control, startup, normal operation, and shutdown of the equipment. The Contingency Plan portion of this document describes the procedures to be followed in case a spill or other discharge of waste materials or hazardous substances occurs during the course of operating and maintaining the GWTP.

Health and Safety procedures are not addressed in this manual. This plan is intended to be used in conjunction with the O&M manuals provided by the manufacturers of the equipment, and as such, it does not focus on routine maintenance and calibration of standard equipment items. Reference to the manufacturers' O&M manuals (includes Volumes 5 through 11) is made throughout this plan, and it is therefore imperative that the plant operator become familiar with those documents as well.

This O&M Manual and Contingency Plan for the GWTP are designed to provide the plant operator with proper background and procedures for day-to-day operation and maintenance of the treatment facility. The manual includes:

- An overall description of the extraction and treatment facilities
- A detailed description of the major extraction and treatment components and support systems
- Individual equipment descriptions, identifying major components, procedures, process control provisions (where applicable); a trouble-shooting guide; and preventive maintenance information
- A sampling and analytical program and a method of record keeping and reporting
- An Emergency Response and Contingency Plan

It should be emphasized that specific maintenance information on each piece of equipment is provided in the equipment manufacturers' O&M manuals included in Volumes 5 through 11 of this manual.

1.1.1 Operations and Maintenance Manual Revision Notes

This manual was developed to incorporate the upgrades added to the GWTP in the spring of 2000 and is to be used in conjunction with the original manual entitled "Operations and Maintenance Manual for the Perimeter Ground Water Containment System and the Barrier Wall and Associated Extraction System" dated July 1997. Following is a summary of the changes to the original manual:

- This Volume 1 replaces the original July 1997 Volume 1 entitled "Operations and Maintenance Plan/Contingency Plan for the PGCS and BWES."
- Volume 4A, containing the as-builts for the GWTP upgrades, has been added.
- Volume 9, containing equipment manufacturers' manuals for new equipment, has been added.
- Volume 10, containing additional equipment manufacturers' manuals for the activated sludge plant and the Catalytic Oxidizer/Scrubber, has been added.
- Volume 11, containing the programmed ladder logic for the upgraded system and program output and reference files, has been added.

There are no other changes to the original manual.

1.2 EXTRACTION AND TREATMENT REQUIREMENTS

From 1997 until completion of the upgrades, the existing GWTP was used to treat groundwater collected from the PGCS and groundwater from the BWES. Influent from the BWES was limited to flowrates sufficient to maintain the groundwater level in the containment area (On-Site Area and Off-Site Area) at a level that would not overflow the barrier wall. During implementation of the Final Remedy, additional influent streams have been generated requiring treatment by the GWTP. New influent streams have been generated due to new equipment and extraction wells, the installation of a separation barrier wall between the On-Site and Off-Site Areas, and segregation of the BWES extraction wells by location. These influent streams have been or will be generated by the following Site activities and sources:

- The lowering of the water table in the Off-Site Area by approximately 8 feet to allow more effective operation of the in-situ soil vapor extraction (ISVE) system that has been installed in the Off-Site Containment Area (OFCA) and the Kapica-Pazmey Area (K-P Area);

- ISVE condensate collected in the knockout tanks of the ISVE systems that has been installed in the OFCA and the K-P Area;
- The lowering of the water table in the On-Site Area by approximately 5 feet to allow more effective operation of the ISVE system that will be installed in the Still Bottoms Pond Area (SBPA);
- ISVE condensate will be collected in the knockout tank of the ISVE system that will be installed in the SBPA; and
- Continued operation of the PGCS.

1.2.1 Extraction Requirements

The design hydraulic capacity of the treatment system is based on flow contributions from the following major sources of contaminated water:

1. The seven extraction trenches (EW-11, EW-12, EW-13A, EW-15, EW-16, EW-19, and EW-20) in the Off-Site Area;
2. ISVE condensate from the OFCA and K-P Area ISVE systems;
3. The three extraction trenches (EW-10, EW-17, and EW-18) in the On-Site Area;
4. Additional extraction wells to be installed in the On-Site Area;
5. ISVE condensate from the SBPA ISVE system; and
6. The PGCS.

Because there are several sources of water that will have high flows for a short period of time and lower flows once steady-state conditions are reached, it is necessary to utilize the schedule proposed for the Final Remedy for sequencing the activities so that the most appropriate treatment system could be designed and operated to meet the project's objectives. The schedule for startup and operation of each of the water-producing activities and the resulting estimated flows to the GWTP is presented in Table 1-1. The schedule is based on the following operational strategy:

Stage 1: Stage 1 commenced upon completion of installation of the separation barrier wall, ISVE systems in the Off-Site Containment Area and K-P Area, and the clay cover in the Off-Site Area. At this time, dewatering of the Off-Site Area and ISVE system operation (including condensate collection) began. Maintenance dewatering in the On-Site Area and groundwater collection by the PGCS has continued. Stage 1 is expected to last for up to one year. The estimated total maximum flow during this stage is 59 gallons per minute (gpm), and the estimated minimum flow during this period is approximately 37 gpm.

Stage 2: Stage 2 will commence when dewatering of the Off-Site Area is complete. At this time, dewatering of the On-Site Area will begin. Maintenance dewatering in the Off-Site Area (maintaining the groundwater constantly at the lowered water level), operation of the ISVE systems in the OFCA and K-P Areas (including condensate collection), and groundwater collection by the PGCS will continue during this stage. Stage 2 is expected to last for approximately eight months. The estimated total maximum flow during this stage is 61 gpm, and the estimated minimum flow during this period is approximately 39 gpm.

Stage 3: Stage 3 will commence when dewatering of the On-Site Area is complete. At this time ISVE system operation in the Still Bottoms Pond Area (including condensate collection) will begin. The following will continue: maintenance dewatering in the Off-Site and On-Site Areas (at the lowered groundwater level), operation of the ISVE systems in the OFCA and K-P Areas (including condensate collection), and groundwater collection by the PGCS. The estimated total maximum flow during this stage is 50 gpm and the estimated minimum flow during this period is approximately 18 gpm.

Based on the estimated flows presented in Table 1-1, the treatment system was sized for a maximum hydraulic capacity of 60 gpm. A maximum design flowrate of 60 gpm was selected due to the maximum capacities of some of the existing equipment. A design flowrate of 60 gpm provides sufficient capacity to treat the maximum flows expected during dewatering of the Off-Site Area (Stage 1) and On-Site Area (Stage 2). The long-term flow to the treatment system is estimated to be 50 gpm (Stage 3).

1.2.2 Expected Groundwater Characteristics

During design of the upgrades, two influent profiles were developed for each of the flow conditions (Stages 1 through 3) shown in Table 1-1. The profiles provided flow-weighted averages for contaminant loading of the treatment system based on projected maximum and minimum hydraulic loading scenarios. Review of the profiles indicated that high contaminant concentrations in the SBPA and OFCA would result in highly contaminated flows from the ISVE condensate collection systems and new extraction trenches/wells installed as part of the Final Remedy. These two source-types of high contaminant concentration significantly impact the quality of the influent.

To provide for the potential for highly variable influent characteristics, the following provisions were incorporated in the design of the GWTP:

1. Influent from the ISVE condensate collection systems, interior extraction trenches and wells in the OFCA and On-Site Containment Area (ONCA), and other sources containing free product are or will be pretreated using a gravity phase separation tank (T-101) and the existing oil/water separator (ME-1). The purpose of this additional treatment is to separate free phase products such as oil and grease and other organic matter from the aqueous-phase groundwater.

2. Following pretreatment of the high strength flows, groundwater from all sources at the Site is combined in an aerated equalization tank (T-102). The dissolved volatile organic compounds (VOCs) in the groundwater are stripped in the aeration tank and the off-gases are treated by catalytic or thermal oxidation (ME-106 or ME-205). The remaining organic compounds such as semi-volatile organic compounds (SVOCs) and residual VOCs are removed in a biological treatment system (ME-101). These remaining organic compounds were calculated as a function of biological oxygen demand (BOD) and chemical oxygen demand (COD) to design the biological treatment system.

3. Additional flows exhibiting the worst case contaminant loadings were added to the influent design scenarios as a factor of safety.

4. Flexibility was provided to allow for effective treatment during minimal hydraulic and contaminant loadings projected to occur during each of the three operating stages.

5. The groundwater extraction trenches are equipped with local controllers, sample ports, and flow meters to monitor the influent from each extraction point and adjust pumping rates as necessary to keep the GWTP within design hydraulic and contaminant loading limits.

Based on the above provisions, design influent contaminant profiles were developed for each stage in the treatment process. These profiles were based on flow-weighted contaminant concentrations from the different sources and the expected contaminant removal in each stage of the treatment process. The expected contaminant removal was determined in the full-scale treatability study conducted from July 1998 through November 1998. The design influent profiles are presented in Table 1-2.

1.2.3 Effluent Quality Criteria

In accordance with the Record of Decision (ROD), treated effluent from the treatment system is discharged to the adjacent wetlands. Although a discharge permit is not required, the substantive requirements of a permit, such as effluent standards, need to be met. For discharges to the wetlands at the ACS Site, Indiana Department of Environmental Management (IDEM) has issued the effluent limits presented in Table 1-3. In addition to the requirements listed in Table 1-3, the following conditions must be satisfied:

- The discharge shall not cause excessive foam in the receiving waters/areas. The discharge shall be essentially free of floating and settleable solids.

- The discharge shall not contain oil or other substances in amounts sufficient to create a visible film or sheen on the receiving waters/areas.

- The discharge shall be free of substances that are in amounts sufficient to be unsightly or deleterious or which produce color, odor, or other conditions in such a degree as to create a nuisance.

- The discharge shall not contain any substance in any amount sufficient to be acutely toxic to, or to otherwise severely injure or kill aquatic life, other animals, plants, or humans.

- The discharge shall not contain any substances or combinations of substances in amounts that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly or otherwise impair the designated use.

- There shall be no debris discharge. Debris is defined as woody material such as bark, twigs, branches, heartwood or sapwood that will not pass through a 1.0-inch diameter round opening and is present in the discharge from a wet storage facility.

1.2.4 Air Emissions

Although no IDEM permit is required for air emissions control because the GWTP is part of a National Priority List (NPL) Site, the GWTP provides adequate controls to prevent venting potentially toxic vapors into the treatment building or to the atmosphere. Specific information on the air emissions limitations and monitoring requirements are included in Volume 2 (Performance Standard Verification Plans (PSVP)) and revised in the Quality Assurance Project Plan (QAPP) (MWH, November 2001). A summary is included in Section 6 of this manual.

1.2.5 Residuals Management

The GWTP generates five types of residuals: (1) non-aqueous phase liquids (NAPL), (2) primary sludge, (3) waste activated sludge, (4) spent carbon, and (5) scrubber blowdown. Until notified otherwise by the United States Environmental Protection Agency (U.S. EPA) or the ACS Technical Committee, all of the materials are managed as an F-listed hazardous waste.

- **NAPL.** Screening analysis results of the NAPL are used to determine the ultimate disposal method for the NAPL.

- **Primary Sludge.** The sludge from the gravity phase separator (T-101), Corrugated Plate Interceptor (CPI) oil/water separator (ME-1), and lamella clarifier (ME-6) is analyzed to determine if it can be landfilled in a Resource Conservation and Recovery Act (RCRA) Subtitle C (hazardous waste) landfill or if it needs to be incinerated. The analytical results are compared to the Treatment Standards in 40 Code of Federal Regulations (CFR) 268.40 Subpart D to make this determination.

- **Waste Activated Sludge.** The sludge from the activated sludge plant (ME-101) is analyzed to determine if it can be landfilled in a RCRA Subtitle C (hazardous waste) landfill, used in landfarming applications, or if it needs to be incinerated. The analytical results are compared to the Treatment Standards in 40 CFR 268.40 Subpart D to make this determination.

- **Spent Carbon.** The spent carbon is returned to the carbon supplier for regeneration and future use.

- **Scrubber Blowdown.** Currently, the scrubber blowdown from ME-106 is recycled into tank T-101 to assist in lowering the pH or the process stream. The lower pH will result in more efficient removal of oil and grease in ME-1 and will decrease the amount of sulfuric acid being added to T-103 to also lower the pH process stream prior to ME-l for treatment. Additional options will be considered in the future as needed.

2.0 PROCESS AND CONTROL DESCRIPTIONS

The treatment system of the GWTP contains the components necessary to provide for flow equalization, free-phase product removal, emulsified product removal, organics removal and destruction, metals removal, solids removal, solids handling, disinfection, and air emission control. A block diagram of the process illustrating the major treatment units is shown on Figure 2-1.

Highly contaminated groundwater from the On-Site and Off-Site extraction wells and trenches; and ISVE condensate collection systems are pumped directly to a gravity phase separation tank (T-101) for removal of free phase materials (NAPLs) (i.e. organic constituents that are present above their solubility limit) and heavier suspended solids. Effluent from separation tank flows by gravity through a mixing tank (T-103) to the Corrugated Plate Interceptor (CPI) oil/water separator (ME-1) for removal of emulsified oils and other NAPLs not removed in the gravity phase separation tank. A de-emulsifying agent is added in the mixing tank and the pH is lowered to approximately 4.0 standard units (S.U.) to contact emulsified oils and other NAPLs. Effluent from the CPI oil/water separator flows by gravity to the aerated equalization tank (T-102).

Low-strength groundwater from the PGCS and less contaminated Off-Site and On-Site extraction trenches/wells is blended with effluent from the CPI oil/water separator for pH adjustment, mixing and aeration in the aerated equalization tank (T-102). The aeration system removes COD, BOD, VOCs, SVOCs, and oxidizes and precipitates metals for removal in the lamella clarifier (ME-4, ME-5, ME-6). The system also blends flows from the various sources to equalize the contaminant loading on downstream processes.

The effluent from the aerated equalization tank (T-102) is pumped to the lamella clarifier (ME-6) to remove suspended solids and precipitated metals. Effluent from the lamella clarifier is pumped to a package activated sludge system (ME-101) to remove COD, BOD, trace VOCs, and SVOCs by biodegradation. This package unit contains two aerated bioreactor zones with an established biomass (mixed liquor suspended solids (MLSS), a clarifier for separation of the MLSS, and two aerobic sludge digesters for storing and processing waste activated sludge. Effluent from the activated sludge system flows through the upflow sand filter (ME-7) to capture any residual particulate matter that escapes clarification. Following sand filtration in ME-7, the groundwater is polished to remove residual contaminants using the sand filter beds (ME-8 and ME-9), granular activated carbon (GAC) systems (ME-33 and ME-34), and ultraviolet oxidation (UV-OX)(ME-2) for disinfection. The pH of the groundwater exiting the final GAC unit is adjusted, if needed, to within the permit-required range of 6 to 9 S.U. and discharged to the wetlands.

The treatment process combines several different physical, chemical, and biological processes to remove both organic and inorganic components from the groundwater.

The system consists of the following major treatment components:

- Gravity Phase Separator (T-101);
- CPI Oil/Water Separator (ME-1);
- Aerated Equalization Tank (T-102) with off-gas treatment (ME-106);
- Lamella Clarifier (ME-6) with Rapid Mix Tank (ME-4), and Flocculation Tank (ME-5);
- Activated Sludge Reactor, Clarifier, and Aerobic Sludge Digester (ME-101);
- Upflow Sand Filter (ME-7));
- UV-Oxidation Unit (ME-2);
- Pressure Sand Filter Beds (ME-8 and ME-9);
- Granular Activated Carbon Units (ME-33 and ME-34);
- Effluent pH Adjustment;
- Organic Sludge Storage and Thickening (T-104 and T-1);
- Inorganic Sludge Storage and Thickening (T-5 and T-4); and
- Sludge Dewatering (ME-12).

Each of the individual process units described in this section is shown on Figure 2-1. The layout of the treatment system within the GWTP building is shown in Figure 2-2. A summary of the design hydraulic and contaminate loadings for each treatment component is shown in Table 2-1.

2.1 BARRIER WALL EXTRACTION SYSTEM

Process Description

The BWES extraction system consists of a series of extraction trenches and dual-phase extraction wells. The original BWES consisted of eight 100 feet long extraction trenches ranging in depth from 16 feet to 25 feet (EW-10, EW-11, EW-12, EW-13, EW-15, EW-16, EW-17, and EW-18). As part of the implementation of the Final Remedy two new extraction trenches (EW-19 and EW-20) were installed and EW-13 was repaired. EW-19 is a 150-foot long trench installed just south ofEW-15 and EW-20 is an approximately 260-foot long trench installed just south of the railroad tracks dividing the On-Site Area and Off-Site Area. Also, as part of the final remedy, twenty-one dual-phase extraction wells will be installed in the SBPA as part of the ISVE system in that area for additional groundwater collection. The locations of the collection trenches are shown on Figure 2-3.

Each extraction trench has a sump at one end that has an in-ground vault for access. There is a pneumatic or electric submersible pump in each sump. Each pump has a local controller located at each well. Each pump can also be controlled from the GWTP. Extraction trench 20 consists of four extraction wells EW-20, EW-20A, EW-20B, and EW-20C. The primary pumping sources for extraction trench 20 are EW-20 and EW-20C, located at either end of the trench. EW-20C is constructed similarly to the other extraction wells and is a "wet well," consisting of a 48" diameter concrete vault. It is equipped with the same submersible electric pump as the other wells. Operation of the wells is continuously evaluated and adjusted based on well conditions.

The trenches and extraction wells are grouped based on location to create five separate influent lines to the GWTP from the BWES (see Table 2-2). When dual-phase extraction wells are later added in the SBPA, they will be combined to form one new separate influent line. These groupings allow the operator to better control the hydraulic and contaminant loading to the GWTP. Also, sample ports and local pump controllers are in each extraction trench vault to provide additional control and monitoring.

The purpose of the BWES extraction system is to maintain the water table within the barrier wall at a level that will not overtop the wall and subsequently potentially contaminate the surrounding area. The BWES is also used to dewater the Off-Site Area and On-Site Area during implementation of the Final Remedy to allow operation of the ISVE systems that have been or will be installed in each area.

As the BWES trenches dewater the areas within the barrier wall, the amount of groundwater extracted is expected to gradually decrease and the contaminant concentrations may increase. Initially the influent flowrates from the BWES, PGCS, and ISVE condensate collection systems may be close to the maximum hydraulic loading of the GWTP. Toward the end of each dewatering stage and during long-term maintenance dewatering, the contaminant loading may approach the maximum design contaminant loading of the GWTP. Consequently, the extraction rate from some of the influent sources will need to be monitored and potentially reduced at the local pump controllers to most effectively control the influent characteristics to the GWTP. Groundwater from the ISVE condensate collection systems and highly contaminated BWES wells/trenches should be routed through the gravity phase separator (T-101) and CPI oil/water separator (ME-1) prior to discharge into the aerated equalization tank (T-102). Groundwater from the PGCS and less contaminated BWES wells/trenches should be routed directly to T-102, bypassing free-product removal. The flowrate of the water entering T-101 needs to be closely monitored because the design flowrate through the free-product removal portion of the GWTP is 30 gpm.

Control Description

Each of the existing BWES extraction sumps is equipped with a submersible electric pump. These pumps are single phase, 240-volt electrical pumps that are locally controlled by "Motor Minder" control units located at each extraction well. The local "Motor Minders" monitor the voltage and amperage draw of its corresponding pump and engage/disengage the pump based on variances in these parameters. As the water level drops below the inlet of the pump, the amperage in the pump drops and the "motor minder" turns the pump off. After a given time interval, pre-set by the operator, the "motor minder" turns the pump on again (32 minutes is the typical value).

A power transformer, 120 volt outlet, and disconnect switch are located in the panel with the "Motor Minder". The Power transformer steps the three-phase, 480 volt power feed down to single phase, 220 volt power for the pumps and single phase, 120 volt power for the outlet.

The electric pumps are expected to be continuously active. A pump will stop if the power supply is shut down for maintenance or due to a system-wide power outage, if water level drops below the pump or if a system shutdown alarm is activated. Power will be restored when the alarm/failure conditions have been corrected and when the water level in Tank T-102 is below the enable set point for the BWES pumps (LL5-102) (adjustable).

The combined influent line from the BWES extraction trenches has a flow meter and transmitter (FE/FIT-108) with instantaneous and totalized flow indication. The flow measurements can be read on the unit itself, but the flow data are also sent to the main PLC for tracking.

2.2 PERIMETER GROUNDWATER CONTAINMENT SYSTEM

Process Description

The PGCS extraction system consists of a 14-foot deep by 1300-foot long extraction trench with three extraction sumps. The extraction trench was constructed using the "single-pass" trencher method and, as a result, it actually consists of three separate trench legs that overlap slightly. Each sump is located at the northern most end of the trench legs. An electric submersible pump is located in each sump (EP-19, EP-20, and EP-21) and all three pumps discharge into a common 2-inch diameter HDPE pipeline that conveys water to the treatment building. All the discharge pipes are buried for frost protection; therefore, pitless adapters were installed on the sump casings to allow for removal of the extraction pumps, if needed.

Because the purpose of the PGCS extraction system is to contain contaminated groundwater before it leaves the site, the system only needs to lower the water table at the trench by about 2 to 4 feet (water level monitoring will confirm this). Based on historic groundwater level data, this has been shown to be sufficient to change the existing groundwater flow direction and control the migration of contaminated water. With this in mind, the extraction pipe in the PGCS trench was placed about 2 to 4 feet off the bottom of the trench.

Because the PGCS pumps are constant speed, a valve was installed on the discharge line of each pump to allow the throttling back of flow. Groundwater extracted from the PGCS trench is routed directly to tank T-102 by opening and closing the respective valves on the influent header located inside the treatment building.

Control Description

Each of the electric submersible PGCS extraction pumps is automatically controlled by the main PLC and a level transmitter located in each of the sumps. The level transmitter sends a 4-20 mA signal to the main PLC. The PLC then sends a signal to the pump's motor starter which is located in the motor control center (MCC) in the electrical room. The water level in each extraction sump is also displayed on the computer screen. Each pump is enabled (i.e., the pump is turned on) when the water level within its sump rises above 628 feet (United States Geological Society (USGS) scale) and the level in tank T-102 is below its low level set point (adjustable parameter, typically 190 inches). The low level set point for EP-19 is designated as LL2-102, the low level set point for EP-20 is designated as LL3-102, and the low level set point for EP-21 is designated as LL4-102. When the water level in the extraction sump drops below 624 feet (USGS scale) or tank T-102 is above its low level set point (adjustable parameter, typically 204 inches) or if one of the various process alarms is activated, the pump operation is disabled (i.e., the pump is shut off). The high level set point for EP-19 is designated as LH2-102, the high level set point for EP-20 is designated as LH3-102, and the high level set point for EP-21 is designated as LH4-102. If the water level in T-102 rises above the high level set point for a particular PGCS pump, that pump will not re-engage until the water level drops below the low level set point for that pump.

If the water level in the extraction sump rises above a user defined high-high level of 633 feet (USGS scale), an alarm is issued at the man-machine interface (MMI) (operator's control computer) indicating a submersible pump failure. The idea of this alarm is to set the high-high level in the sump at an elevation below the normal water table level. If the pump cannot keep the water level in the sump depressed below this point, it means the pump has failed. For startup after extended periods of shutdown, the high-high level should be set at 633 feet because this is the typical water table elevation in the vicinity of the trench. The operator will need to change this value as the trench begins to dewater the area and the general water table elevation drops.

Each pump has a Hand-Off-Auto (HOA) switch located on the MCC so it can be turned off or operated manually. The computer screen also has a HOA switch which can be used to operate the pumps manually be clicking on "Hand". In manual "Hand" operation, the low level shut off does not stop the pump, so it is important to monitor the water level to ensure that the pump is not running dry. An elapsed time meter and a cycle counter are also located on each pump's motor starter to indicate the number of pump starts and the associated total run time. The operator needs to review this information to assess whether or not the pumps are cycling on and off too frequently. If so, the valve on the pump's discharge needs to be throttled back.

The combined influent line from the PGCS extraction trenches has a magnetic flow meter (FE/FIT-802) with instantaneous and totalized flow indication.

2.3 IN-SITU SOIL VAPOR EXTRACTION CONDENSATE COLLECTION SYSTEM

Process Description

There will be two ISVE systems installed within the barrier wall as part of the Final Remedy. The first, which has already been installed and is in operation, has wells in the OFCA and K-P Area with the blower building located in the OFCA. The second will be installed in the SBPA Area. Each of these areas is or will be equipped with a condensate collection and transfer system that consists of a demister, a condensate storage tank, and a transfer pump. Moisture that is removed from the ground by the extraction system will be removed from the vapor by the demister and will drain to the condensate storage tank. These tanks will be equipped with a high level switch, low level switch, and a high-high level switch. The high and low level switches will engage/disengage the transfer pumps. These pumps will pump the condensate to the GWTP for treatment. The high-high level switch will activate an alarm that will notify the operator and shutdown the ISVE system.

Control Description

The ISVE systems will operate fairly independently of the GWTP except for the condensate collection and transfer systems. Each condensate collection and transfer system consists of a demister, a condensate storage tank, and a transfer pump. The demisters will remove moisture from the extracted vapor and discharge it to the condensate storage tank for that ISVE system. These tanks will be equipped with a high level switch, low level switch, and a high-high level switch. The high and low level switches will enable/disable the transfer pumps. These pumps will pump the condensate to the GWTP for treatment. The high-high level switch will activate an alarm that will notify the operator and shutdown the ISVE system. The transfer pumps will be interlocked to the GWTP and will be disabled if an alarm is activated at the GWTP that shuts off the influent sources. The transfer pumps will also be controlled by the water levels in the aerated equalization tank (T-102). The ISVE transfer pumps will be enabled when water drops below the low level set point (operator adjustable, designated as LL7-102) and disabled if the water level in T-102 rises above the high set point (operator adjustable, designated as LH7-102). The set points will be "latched" so that if the water level rises above LH7-102, the pumps will not be re-engaged until the water level drops below the low level set point (LL7-102).

In addition to the interaction between the condensate collection and transfer systems and the GWTP, several operating parameters of the ISVE systems will be monitored at the GWTP MMI. This manual will be either revised when installation of the ISVE systems is complete to incorporate these additions or a new O&M manual will be developed specifically for the ISVE systems.

2.4 GROUNDWATER TREATMENT PLANT INFLUENT HEADER SYSTEM

Process Description

Initially the groundwater treatment system treated groundwater from two influent lines. One line collected water from the PGCS and the second line collected water from the BWES. Groundwater from the PGCS was pumped by the field pumps directly to the aerated equalization tank (T-102). The flowrate for this influent was monitored by a flowmeter (FM-802).

Initially all of the extraction wells from the BWES were headered together in the field and entered the treatment building in one pipe. Water within this pipe was pumped by the field pumps to either the gravity phase separator (T-101) or combined with the influent from the PGCS and discharge to aerated equalization tank (T-102). The BWES influent flowrate was monitored by flowmeter FM-108 and the combined PGCS/BWES influent flowrate was monitored by flowmeter FM-109.

In July 2001 an influent header system for the BWES and ISVE condensate lines was completed. Each of the individual influent lines is equipped with a flowmeter (FM-101 through FM-107), a sample port, and valving to allow the influent from each pipe to be directed to T-101 or to combine with the PGCS influent for discharge into T-102. A summary of the influent lines is shown in Table 2-2.

A summary of the flowmeters and their corresponding monitoring point is summarized below:

Flowmeter	Monitoring Point
FM/FIT-101	Influent from BWES extraction wells EW-10, EW-17, & EW-18
FM/FIT-102	Influent from the SBPA extraction wells
FM/FIT-103	Influent from BWES extraction wells EW-11, EW-12, & EW-13A
FM/FIT-104	Influent from BWES extraction wells EW-11, EW-12, EW-13A, & EW-20
FM/FIT-105	Influent from BWES extraction wells EW-15, EW-16, & EW-19
FM/FIT-106	Influent from the OFCA and K-P ISVE condensate pipe
FM/FIT-107	Influent from the SBPA ISVE condensate pipe
FM/FIT-108	Influent to T-101
FM/FIT-109	Combined influent from PGCS, BWES, & ISVE systems
FM/FIT-802	Influent from the PGCS

Control Description

Flowmeters/transmitters FM/FIT-101 through FM/FIT-107 measure the instantaneous and total flowrate through each of the influent pipes from the BWES and ISVE systems and transmits the flowrates (total and instantaneous) to the PLC for monitoring by the operator at the MMI. The flowrates are transmitted to the PLC by 4-20 mA signals.

Flowmeter/transmitter FM/FIT-802 measures the instantaneous and total flowrate of the influent from the PGCS and transmits the flowrate (total and instantaneous) to the PLC for monitoring by the operator at the MMI. The flowrate is transmitted to the PLC by a 4-20 mA signal.

Flowmeter/transmitter FM/FIT-108 measures the instantaneous and total flowrate of the T-101 influent and transmits the flowrate (total and instantaneous) to the PLC for monitoring by the operator at the MMI and to pace de-emulsifier addition to T-103 by the pacemaker pump P-107. The flowrate is transmitted to the PLC by a 4-20 mA signal. Flowmeter/transmitter FM/FIT-109 measures the instantaneous and total flowrate of the combined influent from the PGCS and BWES and transmits the flowrate (total and instantaneous) to the PLC for monitoring by the operator at the MMI. The flowrate is transmitted to the PLC by a 4-20 mA signal.

2.5 GRAVITY PHASE SEPARATION TANK (T-101)

Process Description

Separation of solids and NAPLs is accomplished using a 38,000-gallon, stainless steel gravity separation tank (T-101) with sufficient holding time (approximately 20 hours at 30 gpm) to allow phase separation. The recovered light NAPL (LNAPL) is decanted from the top of the water and flows by gravity to the oil storage tank (T-6) for off-site disposal. The separation tank is equipped with multiple decant ports to remove layers of LNAPL. The LNAPL discharge line contains a sight glass and sample port to determine the correct level to draw-off the LNAPL. Solids that settle in the separation tank are pumped by sludge pump P-101 to the sludge holding tank (T-5) for thickening, dewatering, and suitable off-site disposal. The sludge pump operates off a timer set by the operator at the MMI or by manual operation based on sludge accumulation. If dense NAPL (DNAPL) is separated in T-101, it is pumped to the oil storage tank (T-6) using the sludge pump (P-101). The sludge pump piping is configured to allow pumping to both tanks T-5 or T-6 with tank T-5 as the primary. However, solids removed from T-101 are often coated with organic matter.

Control Description

The sludge pump (P-101) which is used to transfer collected sludge to the sludge holding tank (T-5) or to the oil storage tank (T-6) is driven by compressed air from air compressor ME-24. The air supply to the pump is controlled by a solenoid valve that operates based on an adjustable timer in the PLC. The operator controls the timer at the MMI by entering the desired pumping frequency and duration. This timer can be overridden by HOA switches located at the pump and the MCC or upon a high level in sludge holding tank T-5 (LAH-5). The run status of the pump is monitored at the alarm panel (RUN-P101) and the MMI. P-101 can be manually operated by turning either of the HOA switches to "Hand" mode.

The tank is equipped with a high level switch (LSH-101) that transmits a signal to the PLC to activate an alarm (LAH-101) and disengage the influent field pumps and recycle pump P-101 upon a high water level in T-101. LAH-101 requires operator acknowledgement to deactivate and return system to normal operation.

2.6 MIXING TANK (T-103)

Process Description

Effluent from the gravity phase separation tank (T-101) flows by gravity though a 1,000-gallon, stainless steel mixing tank (T-103) prior to entering the CPI oil/water separator. De-emulsifier is added and the pH is lowered to 4 S.U. (or as determined otherwise). The de-emulsifying agent addition rate is adjusted by a Stranco pacemaker (P-107) that is regulated by a flow meter (FM-108) located at the influent of the gravity phase separation tank. The pH adjustment system adds sulfuric acid (via metering pumps P-18) to the groundwater to adjust the pH to the level set by the operator at the MMI. The sulfuric acid addition rate is regulated by a pH sensor (CE-103) located in the mixing tank. T-103 is equipped with an electric mixer for mixing (ME-109). The addition of de-emulsifying agent and acid to the influent stream of the CPI oil/water separator assists in the separation and removal of emulsified oils and other NAPLs by the coalescing plates in the oil/water separator.

The pH sensor is equipped with an automatic washing system that washes the sensor with a potable water stream. The frequency and operating duration of the automatic washing system is controlled by the operator at the MMI or by the local HOA switch (HS-103).

Control Description

Mixing tank (T-103) receives effluent from the gravity phase separation tank (T-101). In order to facilitate separating emulsified oils from the groundwater, the pH of the groundwater in T-103 is lowered to approximately 4 S.U. (or as set by the operator at the MMI), through the addition of sulfuric acid to the contents of tank T-103. A pH sensor/controller (CE-103/CIC-103) controls sulfuric acid addition to T-103 by transmitting a 4-20 mA signal to the PLC (the set points for the 4-20 mA signal and corresponding PID loop are set by the operator at the MMI). The PLC activates the acid metering pump (P-18) when the pH level is above the pH set point. The operator also inputs a high pH level and low pH level at the MMI. The PLC also activates the high pH alarm (CAH-103) if the pH rises above the high pH level and activate the low pH alarm (CAL-103) if the pH drops below the low pH level. These alarms are activated at the alarm panel and at the MMI. The actual pH level needs to be monitored at the MMI on a continual basis and the run status of the metering pump is monitored at the MMI and PLC alarm panel (RUN-P18).

The pH sensor (CE-103) is equipped with an automatic washing system that washes the sensor with a stream of potable water. The frequency and operating duration of the automatic washing system is controlled by the operator at the MMI. The PLC opens and closes solenoid valve SV-103 to control the potable wash water stream. SV-103 can also be controlled by a local HOA switch (HS-103). In "Hand" mode, SV-103 is opened; in the automatic operating mode ("Auto"), SV-103 is controlled by the PLC; and in "Off" mode, SV-103 is closed.

A Stranco Pacemaker feed pump (P-107) injects a de-emulsifying agent/potable water mixture into T-103. The de-emulsifier injection rate is controlled feed by pump P-107 and adjusted proportionally to the groundwater influent flowrate into T-101 as measured by flowmeter FM-108 and transmitted by a 4-20 mA signal though the PLC to the feed pump. The operating status of P-107 is monitored at the MMI and PLC alarm panel (RUN-P107)

The mixer in mixing tank T-3 (ME-109) is controlled by an on/off switch built into the mixer.

2.7 CORRUGATED PLATE INTERCEPTOR OIL/WATER SEPARATOR (ME-1)

Process Description

The CPI oil/water separator separates free oils and other free-phase products and solids from the groundwater stream. The recovered emulsified oils, light NAPL (LNAPL), and other organic phase material are removed from the top of the water by an overflow weir and flows by gravity to the oil storage tank (T-6).

Solids that settle out in the CPI oil/water separator are pumped by sludge pump P-12 to the sludge holding tank (T-5) at timed intervals set by the operator at the MMI or by manual operation based on sludge accumulation. The sludge effluent line will be equipped with a sample port and piping/valving configuration to allow the operator to pump dense NAPL (DNAPL) to the oil storage tank T-6. Effluent from the CPI oil/water separator will flow by gravity to the aerated equalization tank (T-102).

Control Description

The CPI oil/water separator does not have any instrumentation or control associated with it. The sludge pump (P-12), which is used to transfer collected sludge to the sludge holding tank (T-5) or to the oil storage tank (T-6), will be driven by compressed air from air compressor ME-24. The air supply to the pump will be controlled by a solenoid valve that will operate based on an adjustable timer in the PLC. The operator will control the timer at the MMI by entering the desired pumping frequency and duration. This timer can be overridden by HOA switches located at the pump and the MCC and upon a high level in sludge holding tank T-5 (LAH-5). The run status of the pump will be monitored at the alarm panel (RUN-P12) and the MMI. P-12 can be manually operated by turning the either of the HOA switches to "Hand" mode.

2.8 AERATED EQUALIZATION TANK (T-102)

Process Description

The aerated equalization tank receives the effluent from the pretreatment system, groundwater from the less contaminated Off-Site and On-Site extraction trenches and wells, and groundwater from the PGCS. Equalization and blending of the individual influent sources is achieved by mixing the tank contents with diffused air from a blower (ME-105). Blower ME-104 is also used as a backup by adjusting the valving at the blower header, but is not "interlocked" to the PLC. Equalization is necessary to provide a relatively constant contaminant mass loading to the downstream components of the treatment processes. The diffused air also strips the majority of the VOCs from the water, and as a result, removes BOD and COD, and oxidizes and precipitates iron and other metals. Ten hours of residence time provides equalization, mixing, and aeration in the influent streams at a flowrate of 60 gpm. The tank has a volume of 36,000 gallons and is 24 feet long, 12 feet wide, and has a depth of 20 feet (approximately 17-foot water depth plus a 3-foot freeboard). The design airflow rate is approximately 400 cubic feet per minute (CFM). A defoaming agent is added to the T-102 influent piping to decrease the amount of foaming in the tank due to aeration and groundwater characteristics. The defoaming agent addition rate is adjusted by a metering pump (P-108) that is regulated by the flow meter (FM-803) located at the effluent of the aerated equalization tank. Effluent from T-102 is pumped to the chemical precipitation unit (ME-4, ME-5, and ME-6) by variable frequency drive (VFD) pumps (P104 and P-105). The air exiting the equalization tank is contaminated with VOCs and is treated in a catalytic oxidation unit (ME-106) which destroys the VOCs. The VOC-free air is then vented to the atmosphere.

Control Description

T-102 is equipped with a level indicating transmitter (LE/LIT-102) to provide information for operating the influent pumps (P-104 and P-105), a coarse bubble air diffusion system which provides air (via blower ME-105) to mix the tank contents and remove contaminants, and a defoamer addition system.

The tank's level indicating transmitter (LE/LIT-102) transmits the continuous tank level via a 4-20 mA signal to the PLC. The MMI is equipped with several operator controlled level set points that enable/disable various system components based on the water level in T-102. A summary of the components, set point identifiers, and operating logic is presented below:

- **P-104 and P-105.** Pumps P-104 and P-105 are disengaged when the water in T-102 drops below Low Level 1 (LL1-102) and engaged when the water level rises above High Level 1 (LH1-102). LH1-102 is "latched" to LL1-102 so that if the water level rises above LH1-102, P-104/P-105 continues to operate until the water level drops below LL1-102.

- **PGCS Pump EP-19.** Pump EP-19 is engaged when the water in T-102 drops below Low Level 2 (LL2-102) and disengaged when the water level rises above High Level 2 (LH2-102). LH2-102 is "latched" to LL2-102 so that if the water level rises above LH2-102, EP-19 will not operate until the water level drops below LL2-102.

- **PGCS Pump EP-20.** Pump EP-20 is engaged when the water in T-102 drops below Low Level 3 (LL3-102) and disengaged when the water level rises above High Level 3 (LH3-102). LH3-102 is "latched" to LL3-102 so that if the water level rises above LH3-102, EP-19 will not operate until the water level drops below LL3-102.

- **PGCS Pump EP-21.** Pump EP-21 is engaged when the water in T-102 drops below Low Level 4 (LL4-102) and disengaged when the water level rises above High Level 4 (LH4-102). LH4-102 is "latched" to LL4-102 so that if the water level rises above LH4-102, EP-19 will not operate until the water level drops below LL4-102.

- **BWES Wells EW-10, EW-17, and EW-18.** These pumps are engaged when the water in T-102 drops below Low Level 5 (LL5-102) and disengaged when the water level rises above High Level 5 (LH5-102). LH5-102 is "latched" to LL5-102 so that if the water level rises above LH5-102, the pumps will not operate until the water level drops below LL5-102.

- **BWES Wells EW-11, EW-12, EW-13A, EW-15, EW-16, EW-19, and EW-20.** These pumps are engaged when the water in T-102 drops below Low Level 6 (LL6-102) and disengaged when the water level rises above High Level 6 (LH6-102). LH6-102 is "latched" to LL6-102 so that if the water level rises above LH6-102, the pumps will not operate until the water level drops below LL6-102.

- **ISVE Condensate Transfer Pumps.** These pumps engage when the water in T-102 drops below Low Level 7 (LL7-102) and disengage when the water level rises above High Level 7 (LH7-102). LH7-102 is "latched" to LL7-102 so that if the water level rises above LH7-102, the pumps will not operate until the water level drops below LL7-102.
- **Recycle Pumps P-9 and P-10 and Level Alarms (LAH-102 and LAL-102).** The permissive for these pumps will be removed if the water drops below LL8-102 and rises above LH8-102. A high level alarm (LAH-102) will be engaged when the water level rises above High Level 8 (LH8-102). A low level alarm (LAL-102) will be engaged when the water level drops below Low Level 8 (LL8-102). Both alarms require operator acknowledgement to deactivate and return system to normal operation.

Pumps P-104 and P-105 are both equipped with variable frequency drives, so once the pumps are started, their speed is modulated by the PLC to maintain the flowrate that the operator inputs into the system via the MMI. Flowmeter/transmitter FM/FIT-803 measures the flowrate through the T-102 effluent piping and transmits the flowrate via a 4-20 mA signal to the PLC to confirm that the desired flowrate is being maintained. If the lead pump (either P-104 or P-105, as set by the operator at the MMI) cannot maintain the set flowrate, the lag pump is started. When the lag pump is started, the PLC automatically ramps down the lead pump speed to match lag pump speed, and the pump speeds are ramped up or down together. If both pumps drop below 30 hertz, indicating a reduced flow requirement, then the lag pump is stopped (first on--last off). Pumps P-104 and P-105 are alternated as lead pumps to equalize run time. When P-104 and P-105 are operated in "Hand" mode, they are operated at the speed set at the MMI. If the tank level drops below Low Level 1 (LL1-102), then P-104 and/or P-105 are disengaged. These pumps are disengaged upon shutdown or failure of blower ME-105 or upon activation of any alarms from process components downstream of T-102. The run status (on/off) of each pump is monitored at the MMI and the PLC alarm panel (RUN-P104 and RUN-P105) and the speed of each pump is continuously monitored at the MMI and at the MCC.

A 400-SCFM, positive displacement blower (ME-105) provides air for the coarse bubble diffusion system. The air discharge pipe of the blower contains a low air pressure indicating switch (PS-105) that activates an alarm (PAL-105) at the MMI, PLC alarm panel and audible upon shutdown or failure of the blower. Upon low air pressure from ME-105, PS-105 relays a signal to the PLC. After an operator set delay period (the delay time has been set by the operator at the MMI), the PLC activates the alarm (PAL-105) and disables the field pumps (BWES, PGCS, and ISVE condensate pumps), the influent pumps (P-104 and P-105), the recycle pumps (P-9 and P-10), and catalytic oxidizer/scrubber (ME-106). Alarm PAL-105 requires operator acknowledgement to deactivate and return system to normal operation. Blower ME-105 also receives a signal from the PLC to disable upon shutdown or failure of the catalytic oxidizer/scrubber unit (ME-106).

Foam suppression in T-102 is accomplished by adding a defoamer to the T-102 influent. The PLC controls the defoamer metering pump (P-108) based on flowrate through flowmeter FM-803. The run status of the pump can be monitored at the MMI and PLC alarm panel (RUN-P108).

2.9 PROCESS FLOWRATE

The flowrate through the main portion of the GWTP is set by the operator at the MMI and the flowrate through the phase separation components (T-101, T-103, and ME-1) are set by manual adjustment of the influent valves in the influent header system. The desired flowrate through the main components of the GWTP is maintained by VFD pumps P-104 and P-105 and flowrate readings from flowmeter FM-803. See Section 2.8 for a more detailed control description. It is recommended that the treatment process be run as a continuous operation with as constant a flowrate as possible. Since the extraction pumps operate in a cyclic mode, the flowrate to the GWTP is set at a flowrate slightly higher than the average daily flowrate from the PGCS and BWES extraction systems and ISVE condensate collections systems. In addition, the flowrate takes into account internal recycle streams. The following formula is used to determine the flowrate set point:

$$Q_{TOT} = Q_{PGCS} + Q_{BWES} + Q_{OFCA\ ISVE} + Q_{ONCA\ ISVE} + Q_{RECYCLE} + \sim 5 \text{ gpm}$$

Where Q represents flowrate is in gallons per minute (gpm).

This flowrate is adjusted based on operating stage and the water levels within the barrier wall as the pumping rates from the BWES extraction trenches has decreased after initial drawdown.

The influent from the BWES and ISVE condensate can be pumped through T-101 and subsequent phase removal components or be pumped directly to T-102. The flow paths from these sources is manually controlled at the influent header system and in the field based on influent flowrates and contaminant loading. If the influent water from any source contains free product (oil, tar, LNAPL, DNAPL, etc.) or excessive suspended solids, it is directed through T-101 and subsequent phase removal components of the GWTP prior to combining with the rest of the influent flow. Please note that the maximum flowrate through T-101, T-103, and ME-1 is 30 gpm.

2.10 LAMELLA CLARIFIER (ME-6)

Process Description

Oxidized iron; other metals such as arsenic, cadmium, selenium, mercury, and zinc; and suspended solids in the effluent of the aerated equalization tank are removed in the chemical precipitation unit (lamella clarifier with rapid mix and flocculation tanks). The unit consists of a rapid mix tank (ME-4), a flocculation zone (ME-5), and a plate settler (lamella clarifier, ME-6) with an internal sludge thickener. The pH of the influent stream is adjusted to approximately 8.5 S.U. (or as set by the operator at the MMI) within the rapid mix tank by feeding sodium hydroxide (pumped by metering pump P-109) to the tank. The rapid mix tank has a retention time of 5 minutes. In this tank, rapid mixing is achieved by a high-speed mixer. This high-speed mixing allows for a rapid pH adjustment, and quick dispersion of added polymer (if polymer is added to the rapid mix tank and not the flocculation tank). Liquid polymer is used to aid in coagulation and flocculation of the metal precipitates and suspended solids and is added to either the rapid mix tank (ME-4) or the flocculation tank (ME-5). The polymer feed system consists of the metering pump (P-25) and Polyblend mixing system (ME-23). Emulsion polymer is fed from a day tank (55-gallon drum) and is diluted to approximately 1 percent by the Polyblend system with potable water before being fed to the rapid mix tank. The flocculation zone has a retention time of 15 minutes. Here, the metal precipitation and suspended solids in colloidal suspension agglomerate onto the polymer and create heavier, solid particles. These solids are then removed in the plate settling zone. The quantity of caustic added for pH adjustment is regulated by a pH meter (CE-102) in the rapid mix tank. Sludge from the settler/thickener unit is pumped (by sludge pump P-13) to the sludge storage tank (T-5) and dewatered using the filter press (ME-12). The pump P-13 operates off a timer set by the operator at the MMI or by manual operation based on sludge accumulation.

The pH sensor is equipped with automatic washing system that automatically washes the sensor with a potable water stream. The frequency and operating duration of the automatic washing system is controlled by the operator at the MMI or by the local HOA switch (HS-102).

Control Description
The chemical precipitation unit is provided with a local control panel mounted near the unit. This control panel has an HOA switch for the rapid mix tank mixer (ME-17), the flocculator (ME-18), the sludge rake/thickener (ME-19), and the polyblend unit. When the switches are in "Auto" mode, any time process flow is detected by flowmeter FM-803, the mixers and flocculators in the chemical precipitation unit are started and the solenoid valve on the water supply to the polyblend unit (ME-23) is opened. Polymer is pumped from its container into the aging chamber of the polyblend unit by the metering pump (P-25) supplied with the unit. The rate at which the polymer is fed into the polyblend unit is automatically adjusted by the main PLC. For example, as the flowrate through the treatment system increases, the amount of polymer injected into the polyblend unit is increased. However, the amount of water passing through the polyblend unit does not change. Therefore, the polyblend unit sends a more concentrated polymer solution to the rapid mix tank as the treatment system flowrate increases and a less concentrated polymer solution as the system flowrate decreases. The initial polymer solution is adjusted by adjusting the feed pump (P-25) speed and the needle valve on the water supply line. The PLC resets the polymer feed according to the following influent flow as detected by flowmeter FM-803. The 4-20 mA signal from the PLC to the polymer blending unit is based on the 4-20 mA signal from FM/FIT-803 to the PLC. If the influent flow discontinues, the water solenoid valve (SV-23) is closed and metering pump (P-25) is stopped.

In order to facilitate settling of the sediment and oxidized metals in the groundwater, the pH of the process water in the rapid mix tank (ME-4) is raised to approximately 8.5 S.U. or as set by the operator at the MMI. Raising the groundwater pH is accomplished by adding caustic (sodium hydroxide) to the contents of the rapid mix tank. A pH sensor/controller (CE-102) controls caustic addition to ME-4 by transmitting a 4-20 mA signal to the PLC. The PLC activates the caustic metering pump (P-109) when the pH level is below the pH set point. The pumping rate of the metering pump is controlled by the 4-20 mA signal and the PID control loop (controlled by the operator at the MMI). The operator will also input a high pH level and low pH level at the MMI. The PLC will also activate the high pH alarm (CAH-102) if the pH rises above the high pH level and activate the low pH alarm (CAL-102) if the pH drops below the low pH level. These alarms will be activated at the alarm panel and at the MMI. The actual pH level will need to be monitored at the MMI on a continual basis and the run status of the metering pump will be monitored at the MMI and PLC alarm panel (RUN-P109).

The pH sensor (CE-102) is equipped with an automatic washing system that automatically washes the sensor with a stream of potable water. The frequency and operating duration of the automatic washing system is controlled by the operator at the MMI. The PLC opens and closes solenoid valve SV-102 to control the potable wash water stream. SV-102 can also be controlled by a local HOA switch (HS-102). In "Hand" mode, SV-102 is opened; in "Auto" mode, SV-102 is controlled by the PLC; and in "Off" mode, SV-102 is closed.

Solids that settle out in the lamella clarifier (ME-6) are pumped by sludge pump P-13 to the existing sludge holding tank (T-5) at timed intervals set by the operator at the MMI or by manual operation based on sludge accumulation. The sludge effluent line is equipped with a sample port and piping/valving configuration to allow the operator to pump DNAPL to the existing oil storage tank T-6.

The sludge pump (P-13), which is used to transfer collected sludge to the sludge holding tank (T-5) or to the oil storage tank (T-6), is driven by compressed air from air compressor ME-24. The air supply to the pump is controlled by a solenoid valve that operates based on an adjustable timer in the PLC. The operator controls the timer at the MMI by entering the desired pumping frequency and duration. This timer can be overridden by HOA switches located at the pump and the MCC and upon a high level in sludge holding tank T-5 (LAH-5). The run status of the pump is monitored at the alarm panel (RUN-P13) and the MMI. P-13 can be manually operated by turning either of the HOA switches to "Hand" mode.

2.11 HOLDING TANK (T-2)

<u>Process Description</u>
Effluent from the chemical precipitation unit flows by gravity to a 5,800-gallon, stainless steel holding tank (T-2) for pumping to the activated sludge plant (ME-101) by the VFD pumps P-3, P-4, and P-5.

<u>Control Description</u>
Tank T-2 serves as a pumping tank to the activated sludge plant (ME-101). The tank has a mixer (not used) and a level indicating transmitter (LE/LIT-2). LE/LIT-2 transmits the continuous tank level via a 4-20 mA signal to the PLC. Pumps P-3, P-4, and P-5 are programmed to maintain a target level (LT1-2) in tank T-2. This target level is entered into the MMI by the operator. When the water level is above the target level (LT1-2) the lead pump (P-3, P-4, or P-5) is started. Pump speed is modulated via a variable frequency drive to maintain the target level. If the lead pump (P-3, P-4, or P-5, as set by the operator at the MMI) cannot maintain the target water level, the lag pump is started. When the lag pumps is started, the PLC automatically ramps down the lead pump speed to match lag pump speed, and the pump speeds are ramped up or down together. If both pumps drop below

30 hertz, indicating a reduced flow requirement, then the lag pump is stopped (first on--last off). If the tank level drops below an operator-specified low level (LL1-2) (set by the operator at the MMI), the pump is disabled. The target level (LT1-2) and the low level (LL1-2) are "latched" so that if the water level drops below LL1-2, pumps P-3, P-4, and P-5 will remain disabled until the water level rises to LT1-2. These pumps can also be disabled upon activation of any alarms from process components downstream of T-2. When P-3, P-4, and P-5 are operated in "Hand" mode, they are operated at the speed set by the operator at the MMI. The run status (on/off) of each pump is monitored at the MMI and the PLC alarm panel (RUN-P3, RUN-P4 and RUN-P5) and the speed of each pump is continuously monitored at the MMI and at the MCC. Pumps P-3, P-4 and P-5 are alternated as lead pumps to equalize run time.

If the tank level rises above an operator-specified high level (LH1-2) (set by the operator at the MMI), the field pumps (BWES, PGCS, and ISVE condensate pumps), recycle pumps (P-9 and P-10), and the influent pumps (P-104 and P-105) are disabled and a high level alarm (LAH-2) is engaged at the MMI, the PLC alarm panel, and audibly. This alarm requires operator acknowledgement to disable.

2.12 ACTIVATED SLUDGE TREATMENT PLANT (ME-101)

Process Description

Groundwater is pumped from tank T-2 into one of the aeration zones of the plant for biological treatment via activated sludge contact. The activated sludge plant (ME-101) is a Model R Groundwater Treatment Plant manufactured by Smith & Loveless, Inc.

The activated sludge system has two distinct aeration zones. Lower hydraulic and contaminant loadings will be directed to the smaller aeration zone while higher loadings will be maintained in both the zones. The concentration of activated sludge in the aeration zones is measured as mg/L of MLSS. The activated sludge utilizes the organic matter as food, thereby reducing the BOD_5 and COD in the groundwater. Trace VOCs are also biodegraded and stripped in this system.

Once the groundwater enters ME-101, it is directed to either one or both of the aeration basins within the plant. The groundwater/activated sludge mixture enters the circular clarifier of ME-101 to separate the activated sludge prior to discharge to the sand filter. The separated activated sludge will be returned by airlift to one of the aeration zones. This return activated sludge is directed to the aeration zones to maintain a sufficient concentration of activated sludge (measured as MLSS) in the aeration tanks so that the required degree of treatment can be achieved in a desired time frame. The quantity of sludge returned to the aeration zones can be adjusted to maintain the target MLSS concentration in each zone. Excess activated sludge, known as waste activated sludge (WAS), is airlifted to the aerobic sludge digester for solids mass reduction via digestion. Digested sludge is pumped to the plant's sludge holding/thickening tank (T-5) and decanted prior to either pressing for off-site disposal or pumping (by P-102) to the second sludge holding/thickening tank (T-104). Air for the aeration system and airlifts is provided by three blowers operating in parallel (ME-102, ME-103, and ME-104). Nutrients (75% nitric acid – HNO_3 or ammonium hydroxide –NH_4OH; and 75% phosphoric acid – H_3PO_4) is provided to the influent piping to tank T-2 by metering pumps P-110 and P-111. Metering pumps P-110 and P-111 are paced off of flowmeter FM-803. These pumps are used to maintain a desired COD:Nitrogen:Phosphorous ratio of 100:5:1.

The plant has an influent hydraulic capacity ranging from 25,900 gallons per day (gpd) to 86,400 gpd and is capable of treating BOD influent concentrations ranging from 500mg/L to 3,500 mg/L. The target food to microorganism ratio (F/M) for the aeration/activated sludge reactor is $0.5d^{-1}$. The Model R unit consists of a 56 foot diameter steel outer tank with a side water depth of 23 feet (total tank depth of 24.5 feet) that contains the following:

- One 37,400-gallon Aeration Zone/activated sludge reactor with coarse bubble diffusers.
- One 261,800-gallon Aeration Zone/activated sludge reactor with coarse bubble diffusers.
- One 43,800-gallon aerobic sludge digester fitted with decant ports capable of providing up to a 9 day hydraulic retention time. The decant ports will allow for flexibility of future plant configuration and operation.
- One 21,900-gallon waste activated sludge holding/thickening zone fitted with decant ports capable of providing a 4.5 day hydraulic retention time.
- One 20-foot, 8-inch diameter steel circular clarifier with waste and return activated sludge airlifts and airlift skimming system, effluent weirs and scum baffles, and effluent discharge.
- Necessary blowers and control system.

Control Description

The activated sludge plant will transmit a high torque condition (NAH-M101) to the PLC if the shear pin in the clarifier's sludge rake/skimmer breaks. If a high torque condition is transmitted to the PLC, then the PLC will engage a high torque alarm (NAH-M101) and disable the field pumps (BWES, PGCS, and ISVE condensate) and upstream process and recycle pump pumps (P-3, P-4, P-5, P-9, P-10, P-104, and P-105). This alarm requires operator acknowledgement to deactivate and return the system to normal operation.

The activated sludge plant also has four internal solenoid valves that control the following: the return activated sludge airlift pump (SV-302), the waste activated sludge airlift pump (SV-301), clarifier scum removal airlift pump (SV-303), and the sludge digester transfer airlift pump (SV-304). Each of these airlifts is controlled by the operator via HOA operation at the MMI. When a valve is in "Hand" mode, the valve is open and the airlift pump is operating. When a valve is in "Off" mode, the valve is closed. When the valve is in "Auto" mode, the valve will open/close based on the duration and frequency input by the operator into the PLC for that particular solenoid valve.

ME-101 contains a high level switch that will transmit a high water level condition to the PLC. Upon high level, the PLC will activate an alarm (LAH-M101) at the MMI and at the PLC alarm panel, and disable the field pumps (BWES, PGCS, and ISVE condensate) and upstream process and recycle pumps (P-3, P-4, P-5, P-9, P-10, P-104, and P-105). This alarm requires operator acknowledgement to deactivate and return the system to normal operation.

Each of the zones in ME-101 contains a coarse bubble diffusion system with air supplied by blowers ME-102, ME-103, and ME-104 (ME-104 is a back-up). The combined air discharge pipe contains a low air pressure switch (PS-102) that transmits a low/no pressure condition to the PLC. The PLC then activates an alarm (PAL-102) at the MMI, the PLC alarm panel, and audibly and disables the field pumps (BWES, PGCS, and ISVE condensate) and the upstream process and recycle pumps (P-3, P-4, P-5, P-9, P-10, P-104, and P-105). This alarm requires operator acknowledgement to deactivate and return the system to normal operation.

The sludge pump (P-101), which is used to transfer collected sludge to the organic sludge holding tank (T-104) or to the filter press (ME-12), is driven by compressed air from air compressor ME-24. The air supply to the pump is controlled by a solenoid valve that operates based on an adjustable timer in the PLC. The operator controls the timer at the MMI by entering the desired pumping frequency and duration. This timer can be overridden by HOA switches located at the pump and the MCC and upon a high level in tank T-104 (LAH-104). The run status of the pump is monitored at the alarm panel (RUN-P13) and the MMI. P-101 can be manually operated by turning either of the HOA switches to "Hand" mode.

Nutrients (nitrogen and phosphorus) are provided to the biomass by adding ammonium hydroxide to the influent piping of ME-101. The injection point for these chemicals is in tank T-2. The PLC controls the metering pumps (P-110 & P-111) based on flowrate through flowmeter FM/FIT-803 that is transmitted by 4-20mA signals from FM/FIT-803 to the PLC and from the PLC to each metering pump. The run status of each pump is monitored at the MMI and PLC alarm panel (RUN-P110 and RUN-P111).

2.13 TURBIDITY METER (DM-101)

Process Description

Effluent from the activated sludge plant (ME-101) flows through a turbidity meter (DM-101) to monitor the turbidity concentration in the groundwater. If the turbidity concentration is below the level inputted into the MMI by the operator, groundwater flows by gravity to the sand filter (ME-7). If the turbidity concentration is above the level inputted into the PLC by the operator, the waste stream is routed back to tank T-2 by two three-way solenoid valves (SV-101A and SV-101B).

Control Description

The turbidity meter/transmitter (DM/DIC-101) measures the turbidity level in the activated sludge plant effluent and transmits the turbidity level to the PLC via a 4-20 mA signal. If the turbidity process stream is above the set point for a specified period of time (the high turbidity set point and duration are set by the operator at the MMI), then the PLC activates high turbidity alarm DAH-101 and closes solenoid valve SV-101A and opens SV-101B to direct water through the recirculate line to tank T-2. Upon turbidity dropping below high level point, the PLC deactivates high turbidity alarm DAH-101 and opens SV-101A and closes SV-101B to direct water along main treatment path to sand filter ME-7. DAH-101 is activated at the MMI, the PLC alarm panel, and audibly.

2.14 SAND FILTER (ME-7)

Process Description

The residual suspended solids in the activated sludge system effluent are removed using the existing upflow, continuous backwash sand filter (ME-7). The continuous backwash eliminates the need for a backwash cycle and associated storage facilities and pumps. Groundwater flows by gravity from the circular clarifier of the activated sludge plant to the sand filter. The circular clarifier provides enough gravity head to pass through the sand bed and into holding tank T-3, which follows the filter, without pumping. Continuous backwashing is provided using an airlift pump, which pumps approximately 5 gpm of flow containing the filtered solids to the sand filter backwash pumping tank (T-105). A submersible pump in T-105 pumps the backwash water to the lamella clarifier or allows the backwash water to flow by gravity to tank T-2. Effluent from the sand filter flows by gravity to an existing holding tank (T-3) and is then pumped to either the UV oxidation unit (ME-2) or the sand filter beds (ME-8 and ME-9) and GACs (ME-33 and ME-34), or both by VFD pumps P-6, P-7, and P-8.

Control Description

The sand filter is a complete package with its own local control panel mounted near the unit. The control panel sends a signal to the PLC indicating its run status. The controls included in the local panel are backpressure gauge on the air supply to the airlift pump, a solenoid valve on the air supply line, and a rotameter on the air supply line. The sand filter also has a gauge to measure headloss across the sand bed. The sand filter contains an internal level switch that automatically enables/disables the solenoid valve on the air supply line upon detection of water flow.

2.15 HOLDING TANK (T-3)

Process Description

Effluent from the sand filter flows by gravity to a 3,500-gallon, stainless steel holding tank (T-3) for pumping to the UV/OX unit (ME-2) by the VFD pumps P-6, P-7, and P-8. If the UV/OX unit is bypassed, water from T-3 is pumped directly to the pressure sand filters (ME-8 and ME-9). T-3 is equipped with a pH adjustment system to adjust the pH of its contents to within the system effluent limits, if needed. The pH adjustment system controls chemical addition (sulfuric acid by metering pump P-19 and sodium hydroxide by metering pump P-21) via a proportional integral derivative (PID) control loop.

Control Description

Tank T-3 serves as a pumping tank for the treatment system effluent. The tank has a mixer, used for pH control, and a level indicating transmitter (LE/LIT-3). LE/LIT-3 transmits the continuous tank level via a 4-20 mA signal to the PLC (4 mA = 23.8 inches; 20 mA = 108 inches. These points can be reset by the operator at the MMI). Pumps P-6, P-7, and P-8 are programmed to maintain a target level (LT1-3) in tank T-3. This target level is entered into the MMI by the operator. When the water level is above the target level (LT1-3) the lead pump (P-6, P-7, or P-8) is started. Pump speed is modulated via a variable frequency drive to maintain a tank level set point of 60 inches. If the lead pump (P-6, P-7, or P-8, as set by the operator at the MMI) cannot maintain the set water level (LT1-3), the lag pump is started. When the lag pump is started, the PLC automatically ramps down the lead pump speed to match lag pump speed, and the pump speeds are ramped up or down together. If both pumps drop below 30 hertz, indicating a reduced flow requirement, then the lag pump is stopped (first on--last off). If the tank level drops below an operator-specified low level (LL1-3) (set by the operator at the MMI), the pump is disabled. The target level (LT1-3) and the low level (LL1-3) are "latched" so that if the water level drops below LL1-3, pumps P-6, P-7, and P-8 will remain disabled until the water level rises to LT1-3. These pumps can also be disabled upon activation of any alarms from process components downstream of T-2. When P-6, P-7, and P-8 are operated in "Hand" mode, they are operated at the speed set by the operator at the MMI. The run status (on/off) of each pump is monitored at the MMI and the PLC alarm panel (RUN-P6, RUN-P7 and RUN-P8) and the speed of each pump is continuously monitored at the MMI and at the MCC. Pumps P-6, P-7 and P-8 are alternated as lead pumps to equalize run time.

The pH of the groundwater in T-3 is adjusted to approximately 7 S.U. (or as set by the operator at the MMI), through the addition of sulfuric acid or sodium hydroxide to the contents of tank T-3. A pH sensor/controller (CE-3/CIC-3) controls sulfuric acid or sodium hydroxide addition to T-3 by transmitting a 4-20 mA signal to the PLC (the set points for the 4-20 mA signal and corresponding PID loop are set by the operator at the MMI). The PLC activates the acid metering pump (P-19) when the pH level is above the pH set point. The PLC activates the hydroxide metering pump (P-21) when the pH level is below the pH set point. The operator can also input a high pH level and low pH level at the MMI. The PLC will also activate the high pH alarm (CAH-3) if the pH rises above the high pH level and activate the low pH alarm (CAL-3) if the pH drops below the low pH level.

These alarms are activated at the alarm panel and at the MMI. The actual pH level needs to be monitored at the MMI on a continual basis and the run status of the metering pump is monitored at the MMI and PLC alarm panel (RUN-P18).

If the tank level rises above an operator-specified high level (LH1-2) (set by the operator at the MMI), the field pumps (BWES, PGCS, and ISVE condensate pumps), the influent pumps (P-104 and P-105) and the tank T-2 pumps (P-4, P-5, P-6) are disabled and a high level alarm (LAH-3) is engaged at the MMI, the PLC alarm panel, and audibly. High level alarm LAH-3 requires operator acknowledgement to deactivate and return the system to normal operation.

2.16 ULTRAVIOLET-OXIDATION UNIT (ME-2)

Process Description

The UV-oxidation unit is used if disinfection of the groundwater is needed to reduce the potential of biological growth on the GAC unit. Disinfection occurs from the direct effect of the ultraviolet light. Hydrogen peroxide or other additives are not required in the disinfection process.

Control Description

The UV oxidation unit is a complete package unit from Calgon Carbon Oxidation Systems. The unit has its own local PLC-based control system which interfaces with the overall control system for the treatment plant. The local PLC transmits the operating status to the main PLC. This status is monitored at the MMI and PLC alarm panel. The unit is typically bypassed or operated without any chemical addition, using the lamp alone to destroy residual organics. For safety reasons, the UV-oxidation unit is manually enabled to run at the local control panel only.

2.17 PRESSURE SAND FILTER BEDS (ME-8 & ME-9)

Process Description

Effluent from either the sand filter or UV-oxidation unit is "polished" in sand filter beds units to remove residual contaminants. The sand filter system consists of two units containing 1,500 pounds of sand media each (ME-8 and ME-9). Each unit has a treatment capacity of 30 gpm and is typically run in parallel to achieve the design flowrate of 60 gpm. Effluent from the sand filter beds flows through the 10,000-lb GAC units (ME-33 and ME-24).

Both sand filter beds are equipped with an external automatic backwash system that activates when the pressure differential between the influent pressure sensor (PE/PIT-201) and the effluent pressure (PE/PIT-202) is greater than the operator set difference. The automatic backwash system operates by pumping water from tank T-1 backwards through each filter unit and into tank T-4. Backwash water flow direction is controlled by a series of automatic valves (SV-201 through 208). Each unit will be backwashed for an operator-defined duration (entered at the MMI). The automatic backwash system can also be set to operate on a operator-defined frequency (entered at the MMI).

Each of the sand filter beds can be packed with 1,500 pounds of granular activated carbon to operate as GAC filters if necessary at a future date.

Control Description
Both sand filter beds are equipped with an external automatic backwash system that activates when the pressure differential between the influent pressure sensor (PE/PIT-201) and the effluent pressure (PE/PIT-202) is greater than the operator-set difference. The pressure from each sensor is transmitted to the PLC by 4-20 mA signals (4 mA = 0 psi; 20 mA = 100 psi). The automatic backwash system operates by using pumps P-1 and P-2 to pump water from tank T-1, pumps P-1 and P-2, backwards through each carbon unit and into tank T-4. The sand filter bed (ME-8) is backwashed first for an operator-defined duration. During backwashing of ME-8, pumps P-6, P-7, and P-8 are disabled; solenoid valves SV-201, SV-202, SV-205, SV-206, and SV-208 are closed; solenoid valves SV-203 and SV- 204 are opened; and pumps P-1 and P-2 are enabled. When backwashing of ME-8 is complete, ME-9 is automatically backwashed. During backwashing of ME-9, pumps P-6, P-7, and P-8 are disabled; solenoid valves SV-201, SV-203, SV-204, SV-206, and SV-207 are closed; solenoid valves SV-202 and SV- 205 are opened; and pumps P-1 and P-2 are enabled.

Backwash activities continue until the specified duration is complete unless the high high level sensor (LSHH-4) is activated or the low level sensor (LSL-1) in tank T-1 is activated.

2.18 GRANULAR ACTIVATED CARBON UNITS (ME-33 & ME-34)

Process Description
Effluent from either the sand filter or UV-oxidation unit is "polished" in the granular activated carbon (GAC) units to remove residual contaminants. The GAC system consists of two units containing 10,000 pounds of carbon each (ME-33 and ME-34). The units have the capability to be operated in series or parallel with any or all units bypassed. Effluent from the GAC units flows through an in-line pH adjustment system prior to discharge.

Control Description
The carbon in the GAC units is replaced as process monitoring indicates. The process monitoring consists of COD analysis by field measurement. The GACs do not require any instrumentation or control. However, each unit has a pressure gauge at both the inlet and effluent pipe to allow the operator to monitor headloss through each vessel. Each vessel is also appropriately piped for a manually activated backwash cycle in the event of a large pressure drop build-up across a GAC bed.

2.19 EFFLUENT PH ADJUSTMENT/METERING SYSTEM

Process Description

The pH of the groundwater exiting the final GAC unit is adjusted to 6 to 9 S.U. (or to a range set by the operator at the MMI) prior to discharge. pH adjustment is accomplished by an in-line pH adjustment system. This system consists of an in-line static mixer (ME-110), an in-line pH sensor (CE-110), and chemical feed pumps (P-20 and P-22). The effluent pH adjustment system may not be operated if the pH adjustment system in T-3 is operated. The pH adjustment system in T-3 is more functional due to longer residence time and better mixing capabilities.

A magnetic-type flowmeter/transmitter (FM/FIT-801) monitors the effluent flowrate (total and instantaneous) and transmit it to the PLC for monitoring at the MMI.

Control Description

The process water is adjusted to a pH of approximately 7.0 S.U. (or as set by the operator at the MMI) prior to discharge to the wetlands. pH adjustment is accomplished by an in-line pH adjustment system. This system consists of an in-line static mixer (ME-110), an in-line pH sensor (CE-110), and chemical feed pumps (P-20 and P-23). The pH sensor controls the pH adjustment by transmitting the pH to the LC via a 4-20 mA signal (4 mA = 0 S.U.; 20 mA = 14 S.U.) The PLC activates the caustic metering pump (P-22) when the pH level is below the pH set point and the sulfuric acid metering pump (P-20) if the pH level rises above the pH set point. The pumping rates of P-20 and P-22 are controlled by 4-20 mA signals from the PLC. The 4-20 mA signals to both P-20 and P-22 are based on the 4-20 mA signal from CE/CIC-110 to the PLC and the PID loop set points at the PLC. The operator can also input a high pH level (typically 9 S.U.) and low pH level (typically 6 S.U.) at the MMI. The PLC also activates the high pH alarm (CAH-110) if the pH rises above the high pH level and activates the low pH alarm (CAL-110) if the pH drops below the low pH level. Also, if the pH goes beyond the desired range, solenoid valve SV-110A closes and SV-110B opens to reroute the process water to tank T-2. When the pH is back within the desired range, SV-110A opens and SV-110B closes to allow the process water to discharge to the wetland. These alarms are activated at the alarm panel and at the MMI. The actual pH level is monitored at the MMI on a continual basis and the run status of each of the metering pumps is monitored at the MMI and PLC alarm panel (RUN-P20, and RUN-P22).

A magnetic-type flowmeter/transmitter (FM/FIT-801) monitors the effluent flowrate (total and instantaneous) and transmits it to the PLC for monitoring at the MMI. The discharge pH is continuously monitored by an in-line effluent pH sensor and transmitted to the PLC via a 4-20 mA signal.

2.20 INORGANIC SLUDGE HANDLING SYSTEM

Process Description

The inorganic sludge handling system provides a means to accumulate and concentrate metals sludge from the lamella clarifier and pretreatment system sludge prior to dewatering for off-site disposal.

Solids that settle out in the gravity phase separation tank (T-101), CPI oil/water separator (ME-1), and lamella clarifier (ME-6) are pumped on an intermittent basis to the sludge holding tank (T-5). Sludge is allowed to settle and thicken in this tank prior to dewatering. T-5 is equipped with multiple decant ports to discharge free water to the filtrate/decant holding tank (T-4). The decant line is equipped with a sight glass so that the operator can assess the quality of the liquid being decanted from the tank. Decant water from T-4 is then pumped back to either the influent of the gravity phase separation tank (T-101) by pump P-10 or the aeration/equalization tank (T-102) by pump P-9. Thickened sludge from the storage tank (T-5) is pumped by pump P-14 to a filter press (ME-12) for dewatering. ME-12 has a 30 cubic foot capacity. Metering pump (P-32) adds a precoat to the filters prior to sludge dewatering to prevent sludge from sticking to the filters. Filter cake from the press drops into the roll-off dumpster and is periodically transported off-site for disposal. Operation of pump P-14, pump P-32, and the filter press (ME-12) are controlled by the local control panel of the filter press. The operation of this equipment can be monitored by the main PLC.

2.20.1 Control Description for Tank T-5

Solids that settle out in the gravity phase separation tank (T-101), CPI oil/water separator (ME-1), and lamella clarifier (ME-6) are pumped on an intermittent basis to the existing sludge holding tank (T-5). T-5 is equipped with a mixer, high level switch, low level switch, and sludge pump (P-14) to transfer sludge to the filter press. The tank also has four decant ports that are manually operated.

The operation of sludge pump (P-14) is controlled by the filter press local control panel (See Section 2.20.3). The operating status of P-14 (RUN-P14) can be monitored at the MMI and PLC alarm panel. When the tank sludge level reaches the high level switch LSH-5, and alarm condition is transmitted to the PLC and sludge pumps P-12, P-13, and P-101 disabled. A high level alarm (LAH-3) is then engaged by the PLC at the MMI, the PLC alarm panel, and audibly. When the tank sludge low level drops below low level switch LSL-5, a signal is transmitted to the PLC for monitoring at the MMI.

2.20.2 Control Description for Tank T-4

This tank receives decant water from tank T-5, water from the floor sumps, backwash from the sand filters, and filtrate from the filter press. Pump P-9 is used to pump water from T-4 to the influent of T-102 and Pump P-10 is used to pump water from T-4 to the influent of T-101. The operator manually selects the pumps and water destination by manually adjusting valves on the effluent of each pump. When the tank level rises above LSH-4, either pump P-9 or pump P-10 (depending on the valve setting) is started and operated until the tank level drops below LSL-4. The operating status of both pumps can be monitored at the MMI, PLC alarm panel, and MCC. If the tank level rises above LSHH-4, high level alarm (LAH-4) is activated at the MMI, the PLC alarm panel, and audibly, and also the PGCS, BWES, and ISVE pumps and process pumps P-1, P-2, P-3, P-4, P-5, P-104, and P-105 are disabled. This alarm requires operator acknowledgement to deactivate alarm and return system to normal operation.

2.20.3 Control Description for the Filter Press (ME-12)

The entire operation of the filter press is controlled by a local control panel located at the unit. The panel control the sequence of the dewatering process, and the support systems which include sludge pump P-14, the precoat feed system, and air supply to the press. The local control panel sends a signal to the main PLC indicating run status (RUN-M12) at the MMI and PLC alarm panel.

2.21 BIOLOGICAL SLUDGE HANDLING SYSTEM

Process Description

Waste activated sludge is pumped from the aerobic sludge digester of the activated sludge plant for mass removal by digestion. An air diffusion system supplies oxygen necessary to achieve sludge digestion in the aerobic digester. Approximately 30% of the Volatile Suspended Solids (VSS) are digested in the aerobic digester. Following digestion, the digested sludge is transferred to the sludge holding/thickening zone of the activated sludge treatment plant. The digested sludge is allowed to settle and thicken for up to 5 days prior to dewatering. Thickened sludge from the activated sludge plant holding/thickening tank is either pumped to the filter press (ME-12) or to a second sludge holding/thickening tank (T-104). Sludge within tank T-104 is allowed to settle and thicken prior to dewatering. T-104 is equipped with multiple decant ports to discharge free water to the existing backwash/decant holding tank (T-4) (See Section 2.20.2 for information regarding T-4). The decant line is equipped with a sight glass so that the operator can assess the quality of the liquid being decanted from the tank. Thickened sludge from the storage tank (T-104) is pumped by pump P-14 for dewatering to a filterpress (ME-12). The filter press operates as discussed in Section 2.20.

2.21.1 Control Description for Tank T-104

Digested sludge is pumped by sludge pump P-102 on an intermittent basis to the biological sludge holding tank (T-104). T-104 is equipped with a high level switch. The tank also has four decant ports that are manually operated.

When the tank sludge level reaches the high level switch LSH-104, and alarm condition is transmitted to the PLC and sludge pump P-102 disabled. A high level alarm (LAH-104) is then engaged by the PLC at the MMI, the PLC alarm panel, and audibly. This alarm condition requires operator acknowledgement to deactivate alarm and re-enable pump P-102

2.22 HOLDING TANK (T-1)

Tank T-1 receives water from the GWTP effluent for backwashing the sand filter beds (ME-8 and ME-9) and is equipped with two effluent pumps, three level switches, and a mixer (not used). When the tank level is below LSH-1, tank T-1 is in "fill mode" to fill it with water for backwashing ME-8 and ME-9. In "fill mode" solenoid valves SV-110A, SV-110B, SV-201 and SV-207 are closed, solenoid valves SV-202, SV-203, SV-204, SV-205, SV-206, and SV-208 are opened and pumps P-1 and P-2 are disabled. When water reaches the high level switch, SV-110A is opened and SV-208 is closed and the system operates as normal (i.e., the effluent is discharged to the wetlands). During automatic backwashing activities for ME-8 and ME-9, the lead pump (either P-1 or P-2) is started by the PLC. Pump P-1 or pump P-2 pumps until the backwash operation is complete or until the water level in T-1 drops below the low level switch (LSL-1). Pumps P-1 and P-2 are automatically alternated by the PLC on successive starts. HOA switches for each pump are provided near the pumps.

2.23 CATALYTIC OXIDIZER/SCRUBBER (ME-106)

<u>Process Description</u>

Approximately 95% stripping efficiencies is achieved for the VOCs in the aerated equalization tank; therefore, off-gases from the aerated equalization tank are routed through a demister to a catalytic oxidation unit. Ninety-five percent destruction efficiencies are expected for each of the individual VOCs. Volatile organic compounds are thermally decomposed into carbon dioxide (CO_2), water vapor, and chlorine. The off-gases from the catalytic oxidizer are vented to a scrubber which reduces chlorine emissions. A recuperative heat exchanger is used to lower the use of natural gas by preheating the off-gases before they enter the catalytic oxidizer.

The CAT-OX unit can be operated in "bypass" or independent mode by turning on the "bypass" mode on the PLC/MMI. This is not a true bypass mode; rather it allows the unit to continue running even when the rest of the system shuts off. Normally, when the system goes down, the CAT-OX unit turns off also. The rest of the system can be restarted remotely, but the CAT-OX unit cannot. The advantage of the "bypass" mode is that if the CAT-OX unit continues to run, the system can be restarted remotely and CAT-OX unit will continue to operate.

<u>Control Description</u>

The catalytic oxidizer and scrubber units (collectively referred to as the CAT-OX unit) are two separate units designed to function as one system. Each unit has its own local control panels (LCP-106A and LCP-106B); however, the local control panel on the scrubber (LCP-106B) is the primary control panel that controls the oxidization/scrubber process and interfaces with the GWTP's PLC. LCP-106B controls the startup logic, the process monitoring, interlocks, and the emergency stop for both the oxidizer and scrubber.

LCP-106B receives the shutdown signal from the GWTP PLC to disable the CAT-OX upon failure or shutdown of blower ME-105, and LCP-106B transmits a shutdown signal to blower ME-105 upon shutdown of the CAT-OX unit or closure of the air inlet valve. A chart recorder is also in the oxidizer control panel that records process flowrate (in SCFM), catalyst inlet temperature and catalyst exit temperature. The control panel on the oxidizer (LCP-106A) is used to monitor the oxidizer process alarms and parameters, control the process components, and transmit the operation status to LCP-106B and the GWTP PLC.

2.24 CAUSTIC STORAGE TANK (T-8)

Process Description
Caustic soda (sodium hydroxide – NaOH) is stored in the caustic storage tank (T-8) for supply to the caustic metering pumps. T-8 contains a low level switch (LSL-8) that activates an alarm to notify the operator that the tank needs to be refilled.

Control Description
When the caustic level drops below level switch (LSL-8), the PLC activates an alarm (LAL-8) at the MMI, PLC alarm panel, and audibly to notify the operator that the tank needs to be refilled.

2.25 SULFURIC ACID STORAGE TANK (T-9)

Process Description
Sulfuric acid (H_2SO_4) is stored in the acid storage tank (T-9) for supply to the sulfuric acid metering pumps. T-9 contains a low level switch (LSL-9) that activates an alarm to notify the operator that the tank needs to be refilled.

Control Description
When the sulfuric acid level drops below level switch (LSL-9), the PLC activates an alarm (LAL-9) at the MMI, PLC alarm panel, and audibly to notify the operator that the tank needs to be refilled.

2.26 STORAGE TANK (T-7)

Process Description
Tank T-7 is a stainless steel storage tank that may be used to store scrubber blowdown water, peroxide for the UV-OX Unit, or other liquid material requiring temporary storage. The interior of T-7 should be properly cleaned prior to changing the nature of its contents. Tank T-7 is equipped with a low level switch (LSL-7) that activates an alarm (LAL-7) to notify the operator when the tank is low and requires refilling.

Control Description
When the contents of the tank fall below the low level switch (LSL-7), the PLC activates an alarm (LAL-7) at the MMI, PLC alarm panel, and audibly to notify the operator that the tank needs to be refilled.

2.27 IN-GROUND SUMPS

Process Description
There are main floor sumps (North, Middle, and South) and one floor sump in the filter press room. Submersible pumps in each sump pump collected water to the influent of tank T-4. The pumps pump water based on an internal ball-type float switch. Each sump is also equipped with a high level switch that activates an alarm if the sump fills up.

There is also a sump located by the aerated equalization tank (T-102) for the outside secondary containment system. This sump contains a submersible pump with internal float switch to pump water collected in the outside secondary containment system to the effluent piping of T-102 for treatment.

Control Description
Each sump pump has an internal float switch that enables/disables the pump. The North, Middle, and South sumps are also equipped with high level switches (LSH-10A, LSH-10B, and LSH-10C) that transmit a high sump level if the pumps cannot sufficiently pump down the sumps. These alarms (LAH-10A, LAH-10B, LAH-106) are activated by the PLC at the MMI, PLC alarm panel, and audibly and require operator acknowledgement to deactivate and return the system to normal operation.

2.28 AIR COMPRESSOR (ME-24)

Process Description
Air compressor ME-24 is a dual 15-horse power motor air compressor capable of 100 SCFM or compressed air at 175 psi. This air compressor and associated air dryer are used to provide compressed air for equipment located in the treatment system building including the filter press, sand filter, sludge pumps, and carbon backwashing activities.

Control Description
The air compressor contains a pressure element (PE/PIT-24) that activates an alarm if the air supply drops below an adjustable set point. The alarms are activated at the MMI, the PLC alarm panel (PAL-24), and audibly.

2.29 PROGRAMMABLE LOGIC CENTER, MAN-MACHINE INTERFACE, AND MOTOR CONTROL CENTER

The Main or Master Control Panel consists of a Nema 12 enclosure housing, an Allen-Bradley SLC-503 PLC system, and a personal computer (PC) (MMI) running INTELLUTION software. The MMI, PLC, and a 24 VDC power supply are protected by a Best UPS. All I/O can be assigned to continuous trend logs so the entire plant can be viewed over time at the MMI via the computer monitor and/or printer. The full MMI capability can be remotely accessed by using INTELLUTION software. The MMI (computer) monitor will schematically depict the plant flow diagram with realtime variables superimposed. The system ladder logic and output/data files are located in Volume 11 of this O&M Plan.

2.29.1 Programmable Logic Controller (PLC)

Signals from the plant instruments (flowmeters, pH transmitters, turbidity meter, level controllers, etc.) are transmitted to the PLC. The PLC displays the readings to the operator via the MMI. The PLC controls the process equipment by using predetermined set points and conditions and operator adjustable set points and conditions (inputted to the MMI by the operator) and transmitting the signal to the equipment (pumps, solenoid valves, blowers, chemical metering pumps, mixers, etc.) An alarm panel is located on the PLC panel door. This alarm panel contains alarm and run lights of most of the equipment in the treatment system.

An emergency stop button is located on the PLC panel door and is used to stop the entire plant operation. An alarm horn is also located on the PLC panel door and is used to audibly annunciate all user selectable alarms.

2.29.2 Man-Machine Interface (MMI)

The MMI is a personal computer that the operator uses to monitor the general operating status of the treatment system and of the individual process equipment, control the flowrate through the treatment system, and input operating set points and conditions.

2.29.3 Motor Control Center (MCC)

The motor control center (MCC) distributes electrical power to the process components and lighting panels. The MCC contains the circuit breakers, disconnect switches, starter, and variable frequency drive for the larger process equipment. Equipment control can be manually operated by HOA switches located on the MCC. The MCC is used by the PLC to enable/disable equipment.

2.29.4 Proportional, Integral, Derivative (PID) Control Loops

Chemical pumping rates for the pH adjustment systems are controlled at the MMI by proportional, integral, and derivative (PID) control loops by 5/04-type controllers. Detailed information pertaining to PID control loop tuning and description is included as Attachment A to this manual. A summary of the primary variables is presented below.

- **Setpoint.** This variable is the target pH setpoint for the particular pH adjustment system. The units of this variable are in standard pH units (S.U.).

- **Gain.** Universally known as proportional gain, the gain factor increases or decreases the output of the metering pump based on the difference in the actual pH to the target pH (the greater the pH difference, the faster the metering pump pumps; the smaller the pH difference, the slower the metering pump pumps). The range proportional gain is from 0 to 327.67.

- **Reset.** Universally known as integral gain, the reset factor increases or decreases the output of the metering pump based on the how long that the difference has existed (if the actual pH has not attained the target for a long time, the pumping rate of the metering pump will increase; if the actual pH has only recently varied from the target pH, then the metering pump pumping rate will be slow). The range for reset is from 0 to 327.67.

- **Rate.** Universally known as derivative gain, the rate factor increases or decreases the output of the metering pump based on the rate of change of the actual pH (if the actual pH is changing slowly, the pumping rate of the metering pump will increase; if the actual pH is changing quickly, then the metering pump pumping rate will slow down). The range for rate is from 0 to 327.67.

See Attachment A for information regarding tuning the PID control loops and setting the gain, reset, and rate.

TABLES

Table 4-1
Initial Equipment Set Points
American Chemical Services NPL Site,
Griffith, Indiana

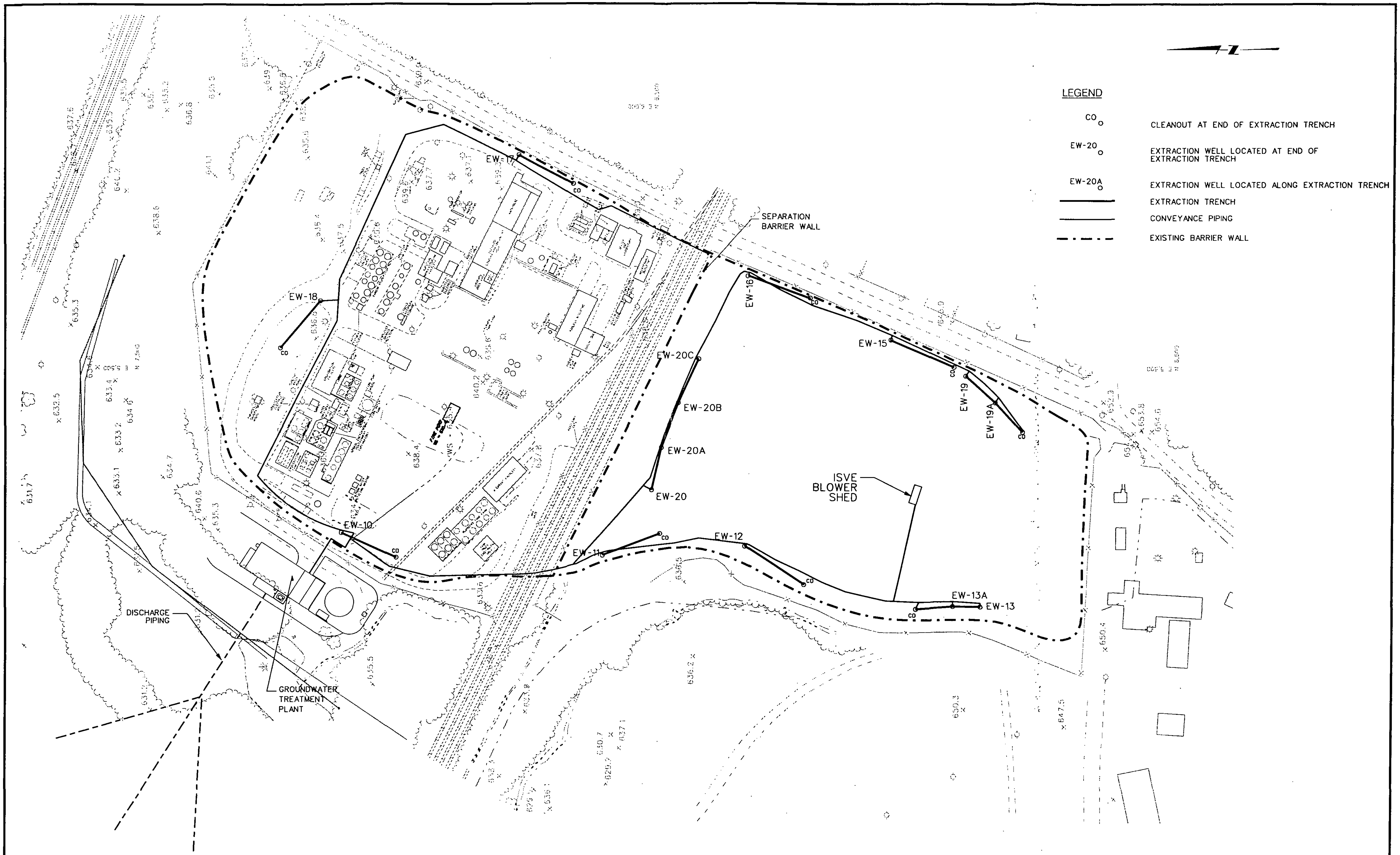
pH Adjustment Systems

Area	Equipment	Signal	Set Point	Action/Description	
Mixing Tank T-103 pH Adjustment System	CIC-103	4 mA	0 S.U.	At	- Calibration set point
		20 mA	14 S.U.	At	- Calibration set point
	P-18	Set Point	4 S.U.	Above	- Activates metering pump P-18
		Gain	8.0	At	- Proportional Gain - based on difference in actual pH from target
		Reset	0.0	At	- Integral Gain - based on the time that the actual pH is different from target
		Rate	0.0	At	- Derivative Gain - based on rate of pH change
	Alarm	High Alarm	7 S.U.	At or Above	- Enables high pH alarm (CAH-103)
		Low Alarm	3 S.U.	At or Below	- Enables low pH alarm (CAL-103)
Lamella Clarifier pH Adjustment System	CIC-102	4 mA	0 S.U.	At	- Calibration set point
		20 mA	14 S.U.	At	- Calibration set point
	P-109	Set Point	8 S.U.	Below	- Activates metering pump P-109
		Gain	4.5	At	- Proportional Gain - based on difference in actual pH from target
		Reset	0.0	At	- Integral Gain - based on the time that the actual pH is different from target
		Rate	0.0	At	- Derivative Gain - based on rate of pH change
	Alarm	High Alarm	9 S.U.	At or Above	- Enables high pH alarm (CAH-102)
		Low Alarm	7 S.U.	At or Below	- Enables low pH alarm (CAL-102)
Final Effluent pH Adjustment System	CIC-110	4 mA	0 S.U.	At	- Calibration set point
		20 mA	14 S.U.	At	- Calibration set point
	P-20/P-22	Set Point	7.5 S.U.	Below	- Activates metering pump P-22
				Above	- Activates metering pump P-20
	Deadband	Range	+/- 1/2 pt. From Set Point		
	Alarm	High Alarm	8.5 S.U.	At or Above	- Enables high pH alarm (CAH-110)
					- Closes solenoid valve SV-110A and opens solenoid valve SV-110B
		Low Alarm	6.5 S.U.	At or Below	- Enables low pH alarm (CAL-110)
					- Closes solenoid valve SV-110A and opens solenoid valve SV-110B
pH Adjustment in tank T-3	CIC-3	Set Point	7.0 S.U.	Below	-Activates metering pump P-21
				Above	-Activates metering pump P-19
	Alarm	High Alarm	8.5 S.U.	At or Above	-Enables high pH alarm (CAH-3)
		Low Alarm	2.5 S.U.	At or Below	-Enables low pH alarm (CAL-3)

Level Controllers[1]

Area	Controller	Level ID	Set Point[2]		Action	
PGCS Extraction pumps			633 feet (USGS scale)		At or Above	- High level alarm activated
			624 feet (USGS scale)		At or Above	- PGCS pump(s) enabled
					Below	- PGCS pump(s) disabled
Aerated Equalization Tank	LE/LIT-102	LL1-102	180 in.	32,300 gal.	Below	- Disables pumps P-104 and P-105
		LH1-102	200 in.	35,900 gal.	Above	- Enables pumps P-104 and/or P-105 until water < LL1-102
		LL2-102	190 in.	34,100 gal.	Below	- Enables PGCS extraction pump EP-19
		LH2-102	202 in.	36,300 gal.	Above	- Disables PGCS extraction pump EP-19 until water level < LL2-102
		LL3-102	190 in.	34,100 gal.	Below	- Enables PGCS extraction pump EP-20
		LH3-102	202 in.	36,300 gal.	Above	- Disables PGCS extraction pump EP-20 until water level < LL3-102
		LL4-102	190 in.	34,100 gal.	Below	- Enables PGCS extraction pump EP-21
		LH4-102	202 in.	36,300 gal.	Above	- Disables PGCS extraction pump EP-21 until water level <LL4-102
		LL5-102	190 in.	34,100 gal.	Below	- Opens SV-24 to enable the On-Site Area BWES pumps
		LH5-102	204 in.	36,600 gal.	Above	- Closes SV-24 to the On-Site Area BWES pump until water level <LL5-102
		LL6-102	192 in.	34,500 gal.	Below	- Enables Off-Site Area BWES pumps
		LH6-102	204 in.	36,600 gal.	Above	- Disables Off-Site Area BWES pumps until water level <LL6-102
		LL7-102	200 in.	35,900 gal.	Below	- Enables ISVE condensate pumps
		LH7-102	206 in.	37,000 gal.	Above	- Disables ISVE condensate pumps until water level < LL7-102
		LL8-102	168 in.	30,100 gal.	Below	- Activates low level alarm (LAL-102)
						- Removes permissive for recycle pumps P-9 and P-10
		LH8-102	211 in.	38,000 gal.	Above	- Activates high level alarm (LAH-102)
						- Removes permissive for recycle pumps P-9 and P-10
		4 mA	0.96 ft.		At	- None (Calibration set point for level controller)
		20 mA	21.08 ft.		At	- None (Calibration set point for level controller)
Holding Tank T-2	LE/LIT-2	LT1-2	60 in.	2,380 gal.	At	- Target water level. Pumping rates of VFD pumps P-3, P-4, and P-5 adjusted to maintain this level
		LH1-2	130 in.	5,155 gal.	Above	- Activates high level alarm (LAH-2)
						- Closes SV-24 to disable the On-Site Area BWES pumps
						- Disables Off-Site Area BWES pumps
						- Disables PGCS extraction pumps
						- Disables ISVE condensate pumps
						- Disables process pumps P-9, P-10, P-104, and P-105
		LL1-2	15 in.	600 gal.	Below	- Disables pumps P-3, P-4, and P-5 until water level > LT1-2
		4 mA	0 in.		At	- None (Calibration set point for level controller)
		20 mA	144 in.		At	- None (Calibration set point for level controller)
Holding Tank T-3	LE/LIT-3	LT1-3	80 in.	3,000 gal.	At	- Target water level. Pumping rates of VFD pumps P-6, P-7, and P-8 adjusted to maintain this level
		LH1-3	96 in.	2,500 gal.	Above	- Activates high level alarm (LAH-2)
						- Closes SV-24 to disable the On-Site-Area BWES pumps
						- Disables Off-Site Area BWES pumps
						- Disables PGCS extraction pumps
						- Disables ISVE condensate pumps
						- Disables process pumps P-3, P-4, P-5, P-9, P-10, P-104, and P-105
		LL1-3	50 in.	1,565 gal.	Below	- Disables pumps P-6, P-7, and P-8 until water level > LT1-3
		4 mA	0 in.		At	- None (Calibration set point for level controller)
		20 mA	108 in.		At	- None (Calibration set point for level controller)

FIGURES



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REV	DATE	DESCRIPTION					

ACS RD/RA GROUP
AMERICAN CHEMICAL SERVICE SUPERFUND SITE
GRIFFITH, INDIANA

GROUNDWATER COLLECTION SYSTEM LOCATIONS

FIGURE 2-3

Change Pages for

OPERATION & MAINTENANCE MANUAL
GROUNDWATER TREATMENT PLANT

Volume 4a of 11

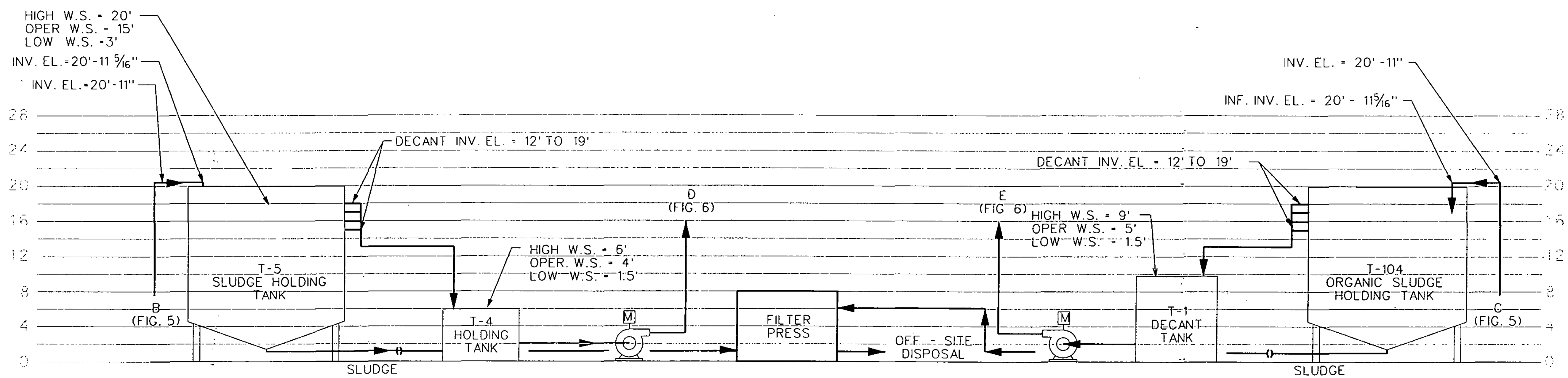
AS-BUILTS FOR THE GROUNDWATER TREATMENT PLANT UPGRADES

AMERICAN CHEMICAL SERVICE NPL SITE
GRIFFITH, INDIANA

July 2002

Attached:

- **Revised Figure 6**



NOTE:

0' ELEVATION CORRESPONDS TO FLOOR ELEVATION OF 637.25' AMSL.

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SUBMITTED BY
ROBERT A. ADAMS (PROJECT MANAGER'S NAME) LICENSE NO. DATE
(COMPANY OFFICER'S NAME) LICENSE NO. DATE

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AMERICAN CHEMICAL SERVICE, INC.
GROUNDWATER TREATMENT SYSTEM UPGRADE
GRIFFITH, INDIANA

HYDRAULIC PROFILE-
SLUDGE HANDLING SYSTEM

SHEET 6

Job No: 209601 File: J:/209/0601 ACS/116 GWTP/drawings/ASBUILTS/acs29prfa.dgn Plot Date: